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*Effective Learning in Low-Tech Information Environments*

**Editors**

Shen Qiao, Hussein Haruna, Zamzami Zainuddin, Natalie Pang, Diane Velasquez, &  
Samuel Kai Wah Chu

# VOLUME 1

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Samuel K.W. Chu | The University of Hong Kong, Hong Kong

### *Effective Learning in Low-Tech Information Environments*

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Association for Information Science and Technology  
8555 16th Street, Suite 850, Silver Spring, Maryland 20910



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# Collaborative e-learning platform for exploring fine-grained behaviors in learning mathematics

**Kam Hong Shum**  
The University of Hong Kong  
khshum@hku.hk

**Lucas Chi Kwong Hui**  
Hong Kong Applied Science  
and Technology Research  
Institute  
[lucashui@astri.org](mailto:lucashui@astri.org)

**Cheuk Yu Yeung**  
MagiCube Limited  
Hong Kong, China  
[leo@magicubedu.com](mailto:leo@magicubedu.com)

**Siu Ming Yiu**  
The University of Hong Kong  
[smyiu@cs.hku.hk](mailto:smyiu@cs.hku.hk)

## ABSTRACT

In this paper, work-in-progress research work of exploring fine-grained learners' behaviors during tablet-based e-learning activities in mathematics is described. Collaborative learning is deployed as the pedagogical intervention adopted in mathematics class of the participating primary schools in this study. An experimental platform called SkyApp is developed to capture how learners collaborate while they are taking part in the learning activities guided by teachers in mathematics class. Based on the data collected by SkyApp, this study aims at exploring the effects of collaboration on the learning traits of performance, engagement, motivation, and emotion of learners. To overcome the limitation of stable Internet services in low-tech information school environments, a mobile WiFi router can be deployed inside the school to link up all tablets and application servers of SkyApp located at the remote site over the Internet. Alternatively, the application server of SkyApp can be located inside the premises of the school so that it can link up to all tablets via a WiFi router connecting to the local area network of the school. In case of a power outage, the tablets can synchronize data with the application server of SkyApp whenever stable electricity is restored. Pilot trials of using SkyApp in a primary school showed that participation in collaborative learning can effectively motivate students in a group to help each other for accomplishing a common goal. However, initial observations also brought up the issue that the composition of individual members in a group may affect the effects of collaborative learning significantly. As the next step of this study, both qualitative and quantitative studies will be carried out to primary 4 to 5 students in two primary schools. The results of data analytics based on the data collected by SkyApp will then be cross-examined with the insights drawn from questionnaires and group interviews with participating students.

## Keywords

Collaborative learning, e-learning, mathematics teaching and learning, learners' behaviors, learning analytics

## Introduction

As defined by Chen et al. (2015), collaborative learning is an instruction method in which students at various performance levels work together in small groups or pairs toward a learning goal. A working paper of OECD (Kärkkäinen & Vincent-Lancrin, 2013) also stated that collaboration can be used to help develop, spread, accelerate and sustain innovation in education. The benefits of adopting collaborative learning in different knowledge domains are also well reported in numerous research studies. As for mathematics learning, significant positive results of applying collaborative or cooperative learning in both primary and secondary mathematics are reported (Slavin, 1985; Whicker, Bol & Nunnery, 1997). In a study conducted by Retnowati, et al. (2017), it is found that collaborative learning is more effective in helping students to learn mathematics by using problem-solving, especially for more complex problems than by using worked examples.

To enhance the quality of collaborative learning in mathematics, computer software can be used to enhance the teaching of some of the more difficult concepts (Swan, 2006). By combining computer support with collaborative learning, computer-supported collaborative learning (CSCL) has emerged as a branch of the learning sciences that focuses on how people can learn together with the help of computers (Stahl, et al., 2006). In addition, Ke and Grabowski (2007) studied the effects of combining teaching techniques of collaborative learning and computer games in improving mathematics education. Their findings suggest that cooperative gaming is an effective strategy of

promoting mathematics learning. They also found that collaboration is more effective than the interpersonal competition in helping positive mathematics learning attitude. The motivation of this study is to conduct new experiments in exploring the effects of collaboration in mathematics e-learning activities using tablet devices. With the capabilities of measuring multi-dimensional data about the input activities of students, fine-grained learners' behaviors can be measured while learners are participating in e-learning activities. The analyzed results will then offer insightful information regarding how collaborative learning relates to the performance, engagement, motivation, and emotion of the learners.

Cooperative and collaborative learning are sometimes used interchangeably by some researchers. In differentiating these two types of learning, Dillenbourg (1999) explained that learners split the learning task, solve sub-tasks individually and then assemble the partial results into the final output in cooperative learning. As for collaborative learning, learners do the learning task together in asynchronous activity and share the conception of a problem. The e-learning activities carried out by this study focusing on the pedagogy of collaborative learning in mathematics.

#### **Collaborative e-learning platform: Skyapp**

An online collaborative e-learning platform called SkyApp is developed for the purpose of fine-grained and high-frequency data collection of learners' behaviors while learners are using it on tablets during mathematics classes. The first version of SkyApp (Yeung et al., 2017) was developed as an iPad App in Objective-C and was tested in two primary schools in 2016. To make SkyApp more portable in running on different types of the tablet (Android & iOS) and PC, the current version (version 3.1) of SkyApp has been completely rewritten in Javascript so that it can run inside any web browser environment. For schools operating under low-tech information environments, stable electricity and Internet services are not always guaranteed. In this case, a mobile Wifi router can be deployed inside the school to link up all tablets and the application server of SkyApp located at the remote site directly over the Internet.

To avoid the dependency on Internet services, the application server of SkyApp can be located inside the premises of the school so that it can link up to all tablets via a WiFi router connecting to the local area network of the school. As long as the tablets of students are connected by WiFi, the usage of SkyApp will not be adversely affected. If there is an outage of power, the tablets can synchronize data with the application server of SkyApp whenever stable electricity is restored. The pedagogical focus of the current version of SkyApp is collaborative learning among learners. SkyApp supports students working in groups, which are formed by two to five students participating in mathematics activities. As shown in Figure 1, learners start their e-

learning activity by first going to an online waiting area until all group members arrive. Then the group members can start working on the same set of questions in a worksheet at the same time. In the example shown in Figure 1, Group 1 has three members, namely User01, User02, and User03.

Groups in the class will compete with each other to finish the same set of questions in the worksheet. Students are therefore motivated by competition among groups. To facilitate collaboration, SkyApp empowers group members not only to work on their own worksheets but also to work on other group members' worksheets for helping their peers by showing the steps of calculation is shown in Figure 2. However, group members can only submit an answer to their own Answer Box and are not allowed to do the submission of answers on behalf of others. In addition, group members can only proceed to the next question in the worksheet after all members have already submitted the same answer (Figure 3). This requirement is to ensure members of the same group proceed to the next question in synchronization. Group members can communicate with each other by exchanging chat messages and working on peers' worksheets. After completing all questions in the worksheet, results of the performance of the work-sheets including total mark scored and time spent will be shown to the students and the teacher in charge.

#### **Exploring fine-grained learners' behaviors**

In this study, fine-grained learners' behaviors will be measured while learners are participating in e-learning activities. The data entries recorded through direct measurements by SkyApp are called learning metrics as shown in Table 1 and as indicated in Figures 1-3. Single or multiple learning metrics can be used to represent specific learning traits of e-learning. Table 2 describes a list of common measurements of students' behaviors (learning traits) of e-learning by learning analytics found in the literature, which include performance (Davies & Graff, 2005), engagement (Richards, 2011), motivation (Hershkovitz, & Nachmias, 2008) and emotion (Rienties, & Rivers, 2014). This study attempts to formulate the patterns of learning traits of learners by analyzing the values of learning metrics.

In the previous study of applying SkyApp version 1.0 (Yeung et al., 2017), learning metrics of total mark (M1), total time (M2) and a number of attempts (M3) were used to measure the participation of 64 primary 4 & 5 students during mathematics e-learning activities in the classroom. By using clustering algorithms on the data of M1, M2 & M3, insightful information about the learning traits of performance and engagement of both individual learners and the whole class can be drawn. It was found that the combined view due to the clustering algorithm on M1, M2 & M3 can help teachers to identify students who need special attention. For example, teachers can identify students who are heavily

engaged but still have unsatisfactory performance and students who are unengaged and perform not well.

With a view to exploring more learning traits by making use of more learning metrics on a specific pedagogical intervention, this study aims to set up a new experimental platform. SkyApp is, therefore, re-designed and re-implemented to support collaborative learning as the pedagogical intervention for this research. In addition to performance and engagement, other learning traits including motivation and emotion will be included in this study. New learning metrics M4 (total amount of workings in the worksheet) and M5 (total number of chat messages and emojis) are therefore introduced in SkyApp version 3.1 that focuses on the pedagogy of collaborative learning. M4 can be further split into two subclasses, one measures the workings on his or her own worksheet (M4a), the other measures the workings on other group members' worksheets (M4b). The latter helps to measure the efforts in helping others due to collaboration. Previous research studies suggest that online text message chatting (Wang et al., 2004) and emoji posting (Fane et al., 2018) can be used to elicit learners' voices and emotions. SkyApp is therefore designed to support online text message chatting and emojis posting among learners for collecting learning metrics of M5. M5 can, therefore, be used to identify the dominant type of affective state of learners and M4 can be evaluated together with M5 to determine the intensity level of the specific dominant affective state.

### **Initial observations & future works**

To prepare for the experiments scheduled in October 2018, one round of pilot trial was carried out in June during the mathematics lessons of one class of primary 4 and another class of primary 5 students in a primary school. 60 students in total were involved in the pilot trial that aims to prepare participating teachers and students to get familiar with the use of SkyApp. Primary 4 and Primary 5 students are selected because the steps required to solve mathematics questions in this level have a suitable level of complexity for SkyApp to capture the data that can be used to analyze the effects of pedagogical interventions. Before using SkyApp, teachers are requested to explain to students the steps of

using SkyApp and to encourage them to help each other in their group. Two major observations are notable; first of all, we found that grouping of students should need to be carefully designed beforehand. We found that some students disliked having groups pre-assigned because some students have preferences on their team members for collaboration. The same observation was reported by Whicker, Bol, and Nunnery (1997). However, grouping according to the preferences of students for each e-learning activity will create heavy administration workloads for teachers. Secondly, we found that the academic capability of individual members in a group will affect the collaborative learning of the group. The most conspicuous effect of collaborative learning appeared to happen when there are both high achievers and low achievers in the group. It is likely that the high achiever will help his or her group members to tackle the difficulty encountered. In addition, low and middle achievers seem to be benefited from collaborative learning more than high achievers. This observation is in line with the research findings of other previous studies in the area of collaborative game playing for mathematics learning (Johnson et al., 1993; De Jean et al., 1999).

As the next step of the current study, experiments will be conducted in primary 4 and 5 mathematics classes using SkyApp. Multi-dimensional data of learning metrics will be collected and analyzed to generate insights into learning traits of collaborative learning based on the model described in the last section. Data analytics will be performed on different combinations of M1-M5 to identify patterns of learning traits of performance, engagement, motivation, and emotion. The quantitative results due to the experiments of using SkyApp will then compare against the results generated from questionnaires and group interviews of the participating students. The insights obtained from the results of questionnaires and group interviews will be used to triangulate the findings of the data analytics through the modeling of learning metrics and learning traits, which will hopefully enable educators to apply machine learning algorithms in modeling learners' behaviors.



Figure 1: Group members wait for each other to start e-learning activity



Figure 2: User01 is helping User02 on the worksheet of User02

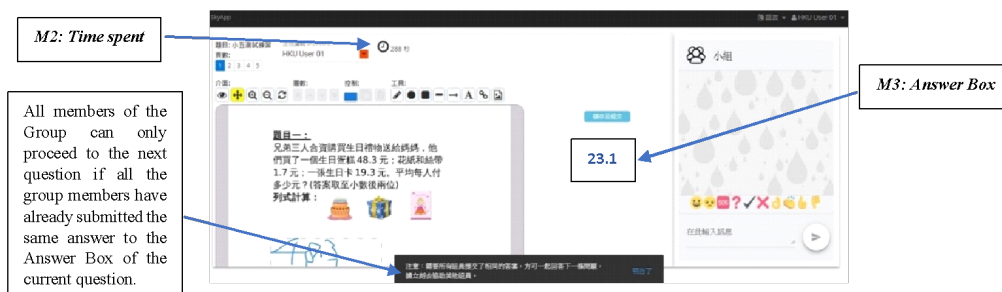


Figure 3: Group members wait for each other to proceed to the next question



<b>Learning Metrics</b>	<b>Short Description</b>	<b>Measurements in the worksheet</b>
M1	Total mark	Total mark scored by submitting correct answers (measured in percentage)
M2	Total time	Total time spent on individual questions (measured in second)
M3	Number of attempts	Maximum number of times a learner changes the contents in the Answer Box of any question
M4	M4a. Total amount of workings on his/her worksheet	Total typing actions on the virtual keyboard and the actions by fingers or stylus on his or her own worksheet or group members' worksheets
	M4b. Total amount of workings on group members' worksheets	
M5	Total number of chat messages and emojis	Total number of chat messages exchanged and the total number of emojis entered

**Table 1. Learning metrics that can be captured by SkyApp**

<b>Learning Traits</b>	<b>Related Learning Metrics</b>	<b>Description</b>
Performance	M1, M2	To understand knowledge acquired in the related topic (M1) and the speed of solving individual questions (M2)
Engagement	M2, M3, M4	To understand whether the learners are committed or distracted during the e-learning activity
Motivation	M2, M3, M4, M5	To understand how motivated the learners are in doing his or her own works and helping other group members (M4)
Emotion	M4, M5	To understand the affective states of learners

**Table 2. Learning traits that can be formulated by combinations of learning metrics**

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# The academic impacts of oxford achiever on Hong Kong primary school students: A self-determination case study

**Yin Jin,**

The University of Hong Kong  
494797650@qq.com

**Shum Yi Cameron Lee**

The University of Hong Kong  
[sycamlee@connect.hku.hk](mailto:sycamlee@connect.hku.hk)

**Min Lee**

The University of Hong Kong  
leeminofficial@gmail.com

**Kai Wah Samuel Chu**

The University of Hong Kong  
[samchu@hku.hk](mailto:samchu@hku.hk)

## ABSTRACT

Gamification is the application of game design elements in non-gaming contexts. To study the impacts of gamification on L2 early English learners, this paper examines the impacts of a gamified e-learning tool on primary school students and presents a case that argues gamified e-learning can effectively help students to learn English. Findings from reading tests, questionnaires, and focus group interviews confirm that argument, providing valuable insight for future e-learning design. Further studies need to be constructed on a longitudinal scale and scrutinize specific game elements to study their impacts on English learning.

## Keywords

E-learning, Gamification, Self-determination, Engagement

## Introduction

E-learning is increasingly popular in Hong Kong's primary and secondary education scenes. In bracing themselves for a boundary-shifting educational landscape that favors technologies overprints, primary and secondary schools naturally tap into e-learning as the next step of their curricular development (Kong et al., 2014, p.193). As stated by Hong Kong Education Bureau, ICT in education evolved from gaining acceptance of the use of ICT as a tool in the First ICT Strategy (1998–2003) to unleashing students' learning potential through tech-supported education in the Fourth ICT Strategy (2014 onwards) (Education Bureau, 2014). Moving forward, the Education Bureau aims to have students develop competencies in areas like self-directed learning, through ICT. Curriculum planners, academic publishers, and educators are thus actively seeking out possible ICT tools to bring about self-directed learning experiences. To that effect, Oxford University Press (China), a local academic publisher, launched the "Oxford Achiever 'Assessment for Learning' System" (OA) in 2012 to help primary and junior secondary school students to self-learn English reading, writing, listening, speaking, grammar, and vocabulary ("Oxford Achiever", n.d.). From the perspective of the students, how exactly an e-learning tool like OA can help them learn English is an underexplored domain of research in the context of Asia. Backdropped by this, the

present study examines the academic impacts of OA on Primary Three (P3) and Primary Six (P6) students in Hong Kong.

## Literature

Breaking the traditional pen and paper approach, online learning channels have presented people with new class format, structure, and delivery that have unprecedented impacts on learning (Shearer et al., 2014). One such impact is the changes to instructional styles. In that picture, teachers can get bogged down by uncommitted students in class whose life is increasingly tech-mediated (Fuchs, 2016); actualizing learning outcomes can thus become difficult. But gamification may be a way out.

## Gamification

Gamification is the utilization of amusement mechanics and components in non-entertainment contexts (Dicheva et al., 2015). Deterding and others (2011) further expanded on that notion by defining the term as the adoption of game elements and game-design techniques for engaging people to solve problems in a non-gaming environment. E-learning is one of those non-gaming contexts, and gamification is heavily utilized (Chan et al., 2016). Affordances that gamification offers are numerous. Foremost is how it helps students to be active learners. Because of a positive feedback system built into game designs, students can self-assess the feedback and use these metacognitive processes to direct themselves towards academic progression and overcome challenges through developing fortitude (Muntean, 2011). Gee (2008) also found that harnessing the ability to complete games and win them promotes creative thinking and boosts productivity. For teachers, that cultivates a learning environment where students can react to disappointment with good faith. Considering that traditional learning makes students passive, a gamified learning environment encourages proactive learning.

## Self-determination theory

The notion that gaming can positively affect learning is not without precedent. Drawing on the success of video games, empirical work that examines gamification from a self-

determination perspective shows promising results (Deci & Ryan, 1985). Self-determination theorists (Deterding et al., 2011) contended that gamification can motivate learners intrinsically. Along this line, Raymer (2011) argued that by integrating game elements into learning activities, students are more likely to understand complex subjects (which fulfills the competence dimension) and are more willing to solve problems on their own (which fulfills the autonomy dimension). This ultimately paves the way for them to connect with peers who are also subject to the same conditions (which fulfills the relatedness dimension). When these three dimensions are met, according to this school of thought, habits nurtured in games endure beyond the period of gameplay. In essence, gamification can empower learners to learn.

## Methods

In this study, a mixed-method approach was used (Creswell & Clark, 2017). Qualitative data from interviews and quantitative data from questionnaires and reading tests helped answer two main research questions:

1. What are the high achievers' perspectives of Oxford Achiever?
2. What can be said about the high achievers from the perspective of self-determination theory?

At the start of the study, P3 students (N=350) and P6 students (N=161) from KF, AS, and TY all took a reading test that modeled after Hong Kong Territory-wide System Assessment. After the test, pre-study questionnaires were administered. All questionnaire items were designed to assess students' motivation (based on the self-determination theory) and level of engagement. These questionnaire items were measured on a four-point Likert Scale with 4 indicating "strongly agree" and 1 indicating "strongly disagree". Following this, students began to use OA. Three months into their usage, semi-structured interviews were arranged for top scorers (i.e. at least 10 practices completed) and their parents. A total of 8 students (3 from KF, 3 from AS, and 2 from TY) and 3 parents (all from AS) took the chance to speak about the platform, which happened between February and March 2018. For students, they were asked 22 questions, including 3 general feedback questions, 10 competence questions, 5 autonomy questions, and 4 relatedness questions. Parent interviews had 15 questions revolving around the themes of English learning, psychology, and general system feedback.

At the end of the intervention, a second round of reading tests, questionnaires, and interviews took place to assess students' learning gains. This time, only students who interacted with the OA platform participated in the post-tests, totaling 157 P3 students and 68 P6 students. The tests were again modeled after the TSA for both grade levels. Towards the end of June, the tests were collected, graded,

and recorded. In the questionnaire, all items were once again based on the self-determination theory and measured on a four-point Likert scale. The questionnaire items this time revolved around students' learning and OA system feedback. In this round of interview, 7 students (including 2 from AS and 5 from KF), 1 parent (whose child goes to AS), and 2 teachers (one from KF and the other from TY) were invited. During the interviews, the students were asked a total of 15 questions, the parents 12 and the teachers 13.

## Results

Data collected from the data sources were evaluated using the Statistical Package for the Social Sciences 11. Overall, reading test scores improved (in pre-study: N=163, M=14.90, SD=4.89; in post-study: N=163, M=15.64, SD=5.876). Table 1 further revealed that the average scores of the post-test increased by 0.74 points compared to the pre-test. This suggests that OA intervention is statistically significant at a 95% confidence level. Since our control group P6 KF's average score of post-test decreases by 4.24 points compared to the pre-test, it can be concluded that without the use of OA, not only could students' English abilities become stagnant, they could have performed worse. As the Sig. value (2-tailed) of P3 students of KF is 0.062, it may not show the degree to which OA is an effective intervention. But the other two groups' results still show that OA is rather successful. AS serves a point. Its post-test scores increased by 3.864 points comparing to its pre-test's. Moreover, the majority of students at AS increased their scores by 1.618 to 6.109 points. This corresponds with a low Std. Deviation about that jump. Table 2 has a detailed breakdown for each top scorer's experience.

## Competence & autonomy

### Listening

TD from AS, as well as LHC and JCH from TY, considered listening as their favorite part of the English lessons. All of them were keen on finishing their listening problem sets on OA, as a result. Given that listening is their strength, TD, and JCH indicated their interest in the listening component. As for LHC, her fondness in listening to English stories prompted her to actively finish the listening questions on OA. Her A-grade on listening tests in school was a testament to her improvement in listening comprehension capabilities. Based on self-determination theory, these students demonstrated that the listening practices enabled them to feel competent. This sense of competence further propelled them to complete the questions on the platform as immediate goals.

### Speaking

LHC has become more confident to speak English at home and in school since she started OA. In her testimony, she told her interviewers that "speaking has become easier [than she used to]," suggesting that she had overcome her fear to

converse in English far back in time. JCH, who was like LHC, also improved his conversational English. His perceived improvement stemmed from the fact that he stepped up his game in English classes, volunteering to answer questions and to help his classmates understand English concepts. A sense of autonomy is observable. Learning through their experiences on OA had helped them to proactively solve problems that they never thought of before, e.g. in situations where most of her classmates “don’t understand the English [questions],” LHC would step in, helping her classmates to overcome challenges that stumped her class mates. In doing so, she “became more active [in school], and more confident in the learning itself”.

### *Reading*

All six interviewees reflected that their reading skills had improved by leaps and bounds. TD and TJ from AS were now able to read between lines for clues, a skill that they believed had allowed them to retrieve the right answer for each question more effectively than before. CHQ from KF also thought that he took more lessons out of his reading, as he discovered new ways of interpreting texts and was able to understand a prompt more in-depth. An intriguing point came from FA of KF, who reported that he got higher grades on his reading tests at school, citing OA as his source for multiple practices outside of class. His experience affirmed the notion that gamified lessons can serve as an effective supplement to traditional classroom lessons. This paves for the way of FA’s sense of competence to shine through and reinforce his takeaway from English lessons.

### *Writing*

Four out of six students saw their English writing skills improved. After using OA, TD was capable of churning out essays with ease, while JCH could express himself better when given writing prompt. Their improvement stemmed in large part to the dense reading comprehension texts they needed to plough through on OA. With a consistently high input of English reading, comprehension, analysis and application, they could write at a consistently decent level. However, not every other student found the platform helpful. CHQ, for one, was most skeptical about the fact that OA could help with writing. LHC agreed with him, suggesting that there is a huge room for improvement for the writing section on OA. “With more keywords [i.e. hints] on the margin,” she said, “I would feel less intimidated to write in English.” Her anecdote represents the woes of many primary school students in Hong Kong, in that writing is an intimidating part of English learning, given their small vocabulary base and a lack of practice outside of class. If this sense of fear for words can be mitigated, a sense of achievement can be cultivated, and in self-determination theorists’ perspective, they will turn out to be more competent writers.

### *Grammar and vocabulary*

In the area of grammar and vocabulary, TD found OA helpful in that she could identify tenses more accurately than before. Commenting on how real-life examples on OA had helped her understand English concepts like word tenses, she told interviewers that she had a fuller understanding of how word tenses operate. Other students (e.g. FA, CHQ, and LHC) also found their grammar and vocabulary had improved. CHQ, in particular, could use more words in sentences now, while LHC’s in-creased exposure to complex sentence structure and word formation on OA allowed her to make an educated guess at new words. A sense of autonomy is thus observable in all these instances.

### ***Relatedness***

Four of the six students mentioned that their interactions with family members or classmates took place more often than before. This coincidentally chimed with the finding by Chen and others (2018), who discovered that Reading Battle, another Hong Kong’s popular e-learning tool, enabled students to “[grow] closer to their parents” (p.7). In this study, similar patterns emerged. TD was now closer to her brother because of OA, while FA and CHQ had more chances to speak with their parents when they encountered problems on OA. Inside the classroom, JCH discussed with his friends more about OA. These interactions between players and their intimate circle helped to stimulate their thinking and compelled them to use the platform even more.

### **Conclusion**

In sum, OA seems to be an effective e-learning platform. Findings suggested that using the platform fulfilled the three basic psychological needs in the students. Considering that the platform is developing a niche market in Hong Kong, a place that undergoes rapidly-evolving tech infrastructure, this study provides an insight for future e-learning platform design. In experimental settings, studies similar to this can be enriched if the students are studied over a longitudinal scale, and if in-game elements such as leaderboard or badges are individually scrutinized for their impacts on learning.

Paired Samples Test											
Schools	Grades			Paired Differences					t	df	p
				Mean	STD	Std. Error Mean	95% Confidence Interval of the Difference				
							Lower	Upper			
KF	P3	Pair 1	Post - Pre Scores	.814	3.990	.430	-.041	1.669	1.892	85	.062
	P6	Pair 1	Post - Pre Scores	-4.240	6.610	1.322	-6.968	-1.512	-3.207	24	.004
AS	P3	Pair 1	Post - Pre Scores	3.864	5.064	1.080	1.618	6.109	3.578	21	.002
TY	P3	Pair 1	Post - Pre Scores	2.367	4.072	.744	.846	3.887	3.183	29	.003

Table 1. Reading Scores between the Three Schools

School	Student	Listening	Speaking	Reading	Writing	Key takeaways
AS	TD (Girl)	Favorite	Need to be improved	Improved	Improved	<ul style="list-style-type: none"> <li>● Increase interest level</li> <li>● Become a proactive student</li> <li>● Increase in <u>interactions with sibling</u></li> </ul>
	TJ (Boy)	/	/	Improved	/	<ul style="list-style-type: none"> <li>● <i>Higher Incentives</i> for using OA due to trophies and stars, etc.</li> <li>● Enhance the sense of achievement</li> </ul>
KF	FA (Boy)	/	Improved	Improved	Improved	<ul style="list-style-type: none"> <li>● Increase in <u>interactions with parents</u></li> <li>● Improvement in vocabulary</li> <li>● A <i>higher incentive</i> for learning</li> </ul>
	CHQ (Boy)	/	/	Improved	Disliked	<ul style="list-style-type: none"> <li>● Improvement in grammar and vocabulary</li> <li>● A <i>higher incentive</i> for learning</li> <li>● Increase in <u>interactions with mother</u></li> <li>● <u>Created opportunity to teach classmates</u></li> </ul>
TY	LHC (Girl)	Favorite	Improved	Improved	Improved	<ul style="list-style-type: none"> <li>● Increase in confidence in speaking,</li> <li>● Improvement in vocabulary</li> </ul>
	JCH (Boy)	Favorite	Improved	Improved	Improved	<ul style="list-style-type: none"> <li>● Eager to speak and answer questions</li> <li>● Increase in <u>frequency of discussion with peers</u></li> </ul>

Table 2. A summary of top scorers' interviews

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# Using pedagogical intervention with ICT to minimize student plagiarism

**Yin Zhang**

Department of Education,  
Ocean University of China,  
Qingdao, P. R. China  
zhangyinouc@sina.com

**Li Xiuhan**

The University of Hong Kong  
Hong Kong  
[u3003557@hku.hk](mailto:u3003557@hku.hk)

**Zamzami Zainuddin**

The University of Hong Kong  
Hong Kong  
zamzamizain@hku.hk

**Samuel K.W. Chu**

The University of Hong Kong  
Hong Kong  
samchu@hku.hk

## ABSTRACT

Plagiarism is rife at universities throughout the world. In response to the increasing problem, exploring educational solutions to it has drawn intensive attention from researchers. However, compared with the punitive approach and ethics education approach, limited empirical research has been conducted to explore how to scaffold students to be free from plagiarism during their academic writing process. Besides, the role of ICT in facilitating plagiarism-related academic writing learning has rarely been discussed in the literature. The study addresses the research gaps through orchestrating UUPC pedagogy, together with an online writing system developed to enrich students' learning experiences with the UUPC. Using a methodological triangulation approach, 38 undergraduates' perceptions and behavioral changes toward plagiarism were collected and analyzed. The results indicated that the UUPC is effective at improving students' understanding of plagiarism, as well as their writing performance in writing from sources.

## Keywords

Plagiarism, UUPC pedagogy with ICT, Academic writing

## Introduction

The prevalence of plagiarism in higher education has received much attention from researchers and educators (Elander, Pittam, Lusher, Fox, & Payne, 2010; Walker, 2010). Concerning instructional approaches to preventing plagiarism, researchers classified anti-plagiarism instructional approaches into three types: punitive approach, ethics education approach, and academic writing instruction approach (Anson, 2003). Compared with the punitive and ethics education approaches, the academic writing instructional approach was believed to better cater to students' learning needs with its features of engaging

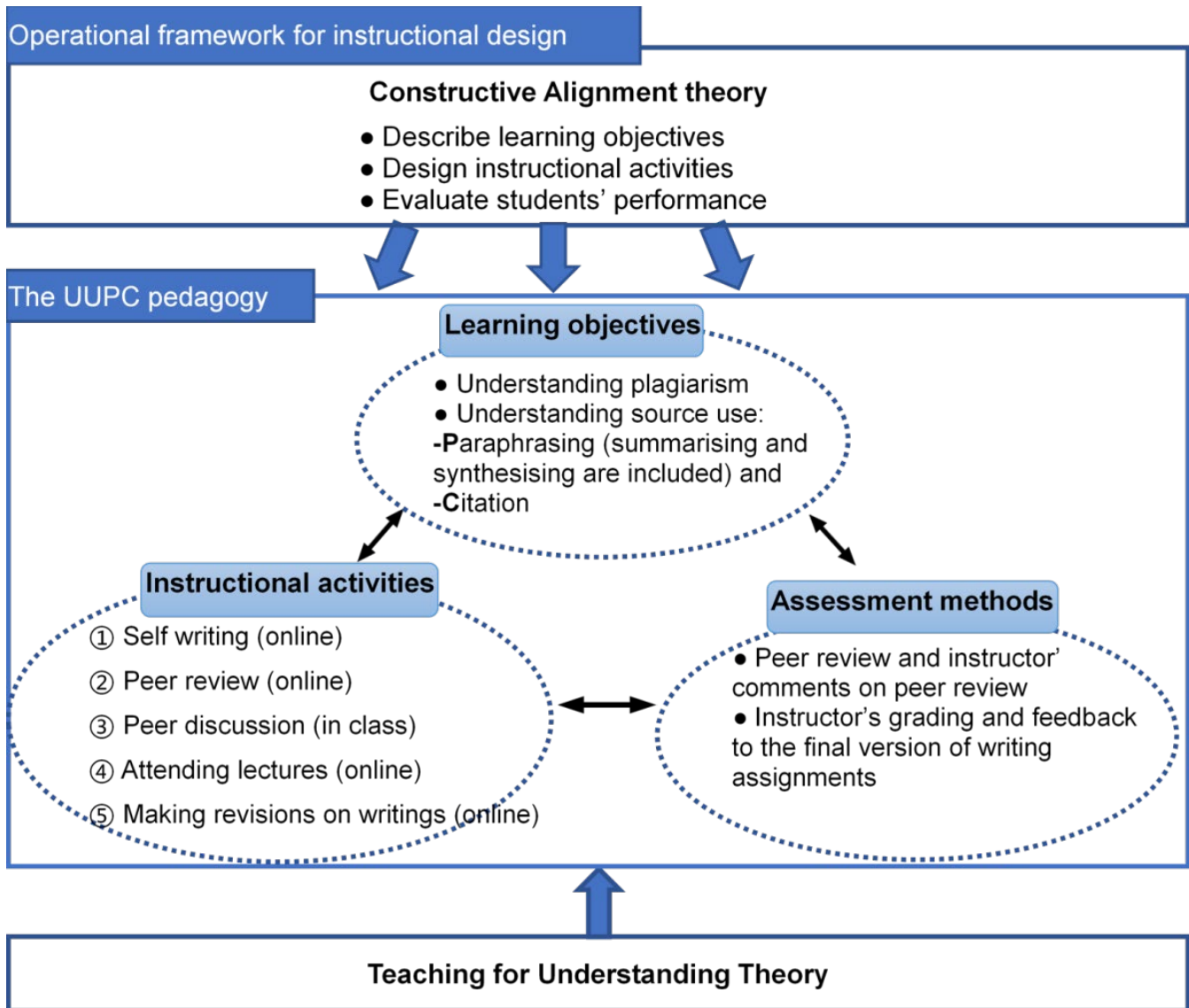
teaching and learning of plagiarism into academic writing practices and facilitating plagiarism-related writing skill development (Hu & Lei, 2015). Even though researchers have put high expectations on the effects of academic writing instruction on preventing plagiarism, empirical research on how academic writing instruction can be developed and implemented to minimize student plagiarism was less mentioned by researchers (Pecorari, 2013). Besides, the participation of subject instructors from disciplines to the construction of plagiarism-related academic writing instruction was even rare in the literature (Howard, Serviss, & Rodrigue, 2010). Moreover, apart from detecting plagiarism (e.g. Turnitin), the role of ICT in facilitating plagiarism-related academic writing learning was seldom discussed before (Liu, Lo, & Wang, 2013).

To bridge these research gaps, the authors designed a new pedagogy named UUPC together with an ICT tool developed to enrich students' learning experiences with the UUPC. The initialism UUPC stands for the learning objectives of the new-designed pedagogy. Specifically, the learning objectives include the Understanding of plagiarism and Understanding of source use, and the latter contains two sub-objectives: Paraphrasing and Citation. To examine the effectiveness of the new pedagogy with ICT tool on students' perceptions and behavioral changes toward plagiarism, a methodological triangulation approach was adopted in the study.

## Theoretical framework of the UUPC pedagogy

This study integrates features of the teaching for understanding theory and constructive alignment theory (Biggs, 2014; Entwistle, 2009), and puts forward a clear theoretical framework of the pedagogy as illustrated in Figure 1.





**Figure 1 Theoretical framework of the UUPC pedagogy**

The adoption of teaching for understanding theory in the study can help define the learning objectives of the targeted anti-plagiarism academic writing instruction, i.e. understanding of plagiarism and understanding of writing from sources. By following Bigg's (2014) operational procedure for instructional design, the instructional activities and assessment methods of the UUPC pedagogy were designed (see the middle square in Figure 1). When students were assigned a writing task, their writing process was guided by the UUPC pedagogy, which includes preparing the first draft of the writing, reviewing each other's writings among peers, discussing with peers about review results, attending their instructor's lecture on plagiarism and source use, and making revisions on their writings according to both the instructor and peer's feedback. By following the instructional activities of the UUPC pedagogy, students

could make reflections on their writing issues, especially the possible plagiarism and source use problems. Moreover, they could have a better understanding of plagiarism-free academic writing by being engaged in writing practices with the help of their peers and instructor. To support students' writing anytime and anywhere and help the instructor know about the writing process, an ICT tool (i.e., the online writing system) was adopted during the process of UUPC intervention.

### **Methods**

#### ***Participants***

38 third-year undergraduate students and their instructor from a subject course titled "Instructional Design" at a public university in mainland China participated in the

study. By analyzing participants' demographic information, it is discovered that students' learning experiences on plagiarism and plagiarism-related academic writing were scarce.

### **Instruments**

In the study, a survey developed based on Lee et al.'s (2016) survey instrument was chosen to collect quantitative data to measure students' perceptions of plagiarism. Students' responses were collected before and after their learning with UUPC pedagogy. Students' writing assignments were analyzed from two dimensions, including the extent of plagiarism and writing performance, to explore their possible behavioral changes to plagiarism. In order to estimate the extent of plagiarism in writings, the degree of similarity and the number of consecutively copied words were used as two different criteria. As there is a severe discussion on the validity of using them in evaluating the extent of plagiarism (Louie & Chairman, 2011), the adoption

of them in the study can help explore their efficacy. What's more, nineteen student participants and their instructor were chosen for an interview regarding their opinions and attitudes towards learning and teaching with the UUPC pedagogy.

### **Results**

#### ***Students' perceptions of plagiarism***

Part of the survey is shown in Table 1, from which it can be seen that students' responses towards plagiarism are generally high with most ratings above the mid-point (3.5) on the 6-point Likert scale. The Wilcoxon Signed-rank test was utilized to determine the difference in students' perceptions of plagiarism between pre and post pedagogical intervention, and significant statistical differences ( $p < 0.05$ ) were found on seven items ( $n=10$ ). However, students' responses to Q2, Q4, and Q7 didn't change dramatically after the intervention, which showed that there remains space for students to learn about plagiarism.

	Survey Items	Mean (SD)		p value (Wilcoxon)
		Pre (n=38)	Post (n=38)	
1.	I am capable of identifying plagiarism-involving cases.	4.00 (1.273)	4.66 (.909)	<b>.005</b>
2.	I am capable of avoiding plagiarism.	4.03 (1.174)	4.45 (.978)	.059
3.	I have a good understanding on the importance of avoiding Plagiarism	4.76 (1.195)	5.18 (.766)	<b>.048</b>
4.	Plagiarizing is the same as cheating in an exam.	4.63 (1.125)	4.92 (1.050)	.079
5.	Adding other's writing texts to my writing assignment without acknowledging the source is plagiarism.	4.82 (1.062)	5.68 (0.525)	<b>.000</b>
6.	Paraphrasing other's writing, and adding it to my writing assignment without acknowledging the source is plagiarism.	3.82 (1.353)	5.03 (1.284)	<b>.000</b>
7.	Adopting other's ideas, not texts to my writing assignment, doesn't need to acknowledge the source, and it is not plagiarism.	3.47 (1.484) *	4.03 (1.716)	.060

Notes: Ratings are based on a 6-point Likert scale: 1 – “Strongly disagree” and 6 – “Strongly agree”.

\*Mean score below mid-point.

Critical value for significance in the Wilcoxon Signed-Rank tests is 0.05

**Table 1. Students' perception of plagiarism**

#### ***Students' writing performance***

To estimate the possible changes of plagiarism extent in writings, a comparison of the previous and current students' writing performance was conducted (as shown in Table 2). Findings imply that the UUPC pedagogical intervention greatly improved the current students' writing performance

from the perspective of consecutively copied words. As there had been statistical differences between previous and current students' writings from the perspective of the degree of similarity before UUPC, it may be not possible to explore changes of plagiarism extent in students' writings by using a degree of similarity.

Items	Median (IQR)			p value (Man-Whitney U)		p value (Wilcoxon)
	Pre (n=38)	Cur (n=38)	CurU (n=37)	Pre vs. Cur	Pre vs. CurU	Cur vs. CurU
1. Most consecutively copied words	68.00 (70.00)	81.00 (65.00)	53.00 (69.00)	.975	<b>.033</b>	<b>.000</b>
2. Degree of similarity	.28 (.22)	.17 (.21)	.18 (.17)	<b>.002</b>	<b>.000</b>	.437

Notes:

'Pre' refers to previous students' writings, 'Cur' refers to current students' writings before UUPC intervention, and 'CurU' refers to current students' writings after UUPC intervention.

Critical value for significance in the Man-Whitney U tests is 0.05.

Critical value for significance in the Wilcoxon tests is 0.05.

**Table 2. The extent of plagiarism in writings**

Apart from being evaluated for plagiarism extent, students' writing performance was measured by a four-dimensional rubric which was designed based on Liu et al.'s (2013) research. As shown in Table 3, the results showed that the

current students' writing performance was comparably better than the previous students' in terms of coherence and cohesion, vocabulary and language use, and citation.

Items	Mean (SD)		p value (Man-Whitney U)
	Pre (n=38)	CurU (n=37)	
1. Assignment response	19.93 (5.53)	21.96 (3.73)	.184
2. Coherence and cohesion	19.54 (3.72)	22.57 (3.15)	<b>.000</b>
3. Vocabulary and language use	17.57 (3.70)	20.34 (3.40)	<b>.002</b>
4. Citation	13.36 (7.03)	19.73 (2.62)	<b>.000</b>
<b>Writing Score</b> (including all four aspects above)	70.40 (13.91)	84.60 (10.47)	<b>.000</b>

Notes:

'Pre' refers to previous students' writings, 'CurU' refers to current students' writings after UUPC intervention.

Critical value for significance in the Man-Whitney U tests is 0.05.

**Table 3. Source use in writings**

### **Student and teacher interviews**

Interviews were conducted with 19 students and their instructor. Findings showed that the interviewed students and instructor exhibited positive attitudes towards learning and teaching with the UUPC pedagogy, as well as using the online writing system. The instructor added that the UUPC helped raise students' awareness of avoiding plagiarism and facilitate students' engagement with writing from sources.

### **Discussion**

#### ***The effects of UUPC on students' perceptions and behavioral changes to plagiarism***

The research demonstrated that both students' perceptions of and behaviors towards plagiarism were positively changed by the UUPC pedagogy. Indeed, most students' perceptions of plagiarism have been greatly improved by participating in academic writing with the UUPC pedagogy. Meanwhile, students' behavioral changes to plagiarism also notably showed that, compared with previous students, current students' writing performance has been enhanced by the

UUPC pedagogy, especially in four aspects, i.e. coherence and cohesion, vocabulary and language use, citation, and avoidance of using consecutively copied words. It infers that the adoption of UUPC not only helps minimize plagiarism in writings but also help improve academic writing quality. Apart from the noticeable acceptance of the UUPC pedagogy, both students and their instructor showed their satisfaction with the new ICT tool (i.e., the online writing system).

#### ***Correlation between students' perceptions and behaviors towards plagiarism***

The current students improved greatly in their 'performance of understanding' (Entwistle, Karagiannopoulou, Ólafsdóttir, & Walker, 2015) of plagiarism and source use, which is in line with their general positive responses to the identification of plagiarism in surveys. In terms of the contradictory findings, even though students showed their agreements to the question "adding other's writing texts to my writing assignment without acknowledging the source is plagiarism" (as shown in Q5 of Table 1), 53% of students

( $n=38$ ) did not make citations in texts. It infers that there still needs more writing practices and instructional supports to facilitate students' understanding of plagiarism.

### Conclusion

This research examined the effectiveness of the UUPC pedagogy with an ICT tool on students' perceptions and behavioral changes toward plagiarism. The findings emphasize the significance of developing anti-plagiarism writing instruction to improve students' understanding and capabilities of being free from plagiarism during their academic study. Both students and their instructor's experiences with the new pedagogy unfolded in the study will encourage the diffusion of the UUPC pedagogy in different instructional settings, as well as motivate subject instructors from various disciplines to take joint efforts to help students cope with plagiarism. The research also suggests that the adoption of ICT tool in anti-plagiarism instruction can help build an open learning community for students to actively communicate with peers and facilitate plagiarism problem-solving.

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# Applying a high-tech gamified reading e-quiz platform for fostering children's low-tech reading behavior

**Li Xiuhan**

The University of Hong Kong  
Hong Kong  
u3003557@hku.hk

**Yin Zhang**

Department of Education,  
Ocean University of China,  
Qingdao, P. R. China  
zhangyinouc@sina.com

**Zamzami Zainuddin**

The University of Hong Kong  
Hong Kong  
zamzamizain@hku.hk

## ABSTRACT

The educational literature suggests that today's children are reluctant to read because of a decrease in reading motivation. Gamified learning, supported by high information and communication technologies (ICTs), has gained popularity in recent years and is now viewed by educators as an effective approach to facilitate pre-adolescent learning (Kapp, 2012). This study seeks to apply a gamified learning platform called "Reading Battle (RB)" in Hong Kong primary students and investigates the effects of it on their reading experience. Adopting a mixed-method approach, this study fulfilled its quantitative objective by mining the data from RB online system and invited 37 students, 20 parents, and 7 teachers to face-to-face interviews. The results show that RB helps foster children's active reading habits, improve their academic performance and related competence, and boost their reading motivation. It is enlightened that the model of RB with little limitation of technologies is user-friendly for primary students. More discussion is presented in terms of the implementation of RB in low-tech areas or groups.

## Keywords

gamified learning, e-quiz, gamified reading, gamification

## Introduction

Reading is a basic cognitive activity in human life and has long-term effects on a child's learning and social development. However, today's children prefer digital entertainment (e.g., Internet surfing & video games) instead of offline printing reading (Flood, 2015). Meanwhile, there is a growing importance and application of information and communication technologies (ICTs) on learning. Many studies show that the ubiquity of high-tech (e.g., computers, the Internet, & smartphones) can foster students' learning interest and enhance learning outcomes (Cheung & Slavin, 2013). For primary students, it is cautious to learn with high-tech due to many considerations. They cannot access high-tech devices freely such as smartphones and laptops. Also, they need to be guided to use computers and the Internet

appropriately with the help of teachers and parents. Therefore, it is challenging to utilize limited high-tech information tools and environments for fostering primary students' learning outcomes. In this study, we seek to apply a high-tech gamified reading e-quiz platform to foster children's low-tech reading behaviors and draw children's attention back to printing books.

## Literature review

The use of educational ICTs has been growing at a dramatic rate in both formal and informal learning in recent years. Popular tools for e-reading include e-books, text-to-speech functions, and online reading programs, which are designed to monitor, guide, and build up knowledge in the users. Studies show that technology-enabled reading programs can develop readers' intrinsic motivation, leading to an improvement in reading comprehension as well as academic performance (Ciampa, 2012). However, previous technology-enabled reading programs stimulate children's online reading behaviors but keep away from reading printing books. In low-tech areas, offline reading is still the most recommended reading mode for children. Limited literature gave the answer of how to promote children's offline reading through the assistance of educational ICTs.

Gamification is one of the most popular applications of ICTs to increase users' engagement and motivation in education (Kapp, 2012). Gamification is defined as using game thinking and elements in a non-game context (Kapp, 2012). Game elements include but not are limited to points, badges, leaderboards, progression, status, levels, rewards, and role. Many studies have shown that gamification can greatly facilitate people's engagement and motivation, leading to an increase in the time and efforts they are willing to spend in a target activity. Therefore, it is an effective approach to utilize gamification to improve students' learning outcomes. Gamification in learning, or gamified learning, seeks to enrich traditional learning by applying gameplay elements to the contents, environments, and strategies. A number of researchers have looked into the effects of gamified learning, such as increasing learners' engagement, stimulating

learning motivation, changing learners' attitudes toward learning, and improving academic performance and competence (Dicheva et al., 2015). The working mechanism of gamified learning is due to the effective scaffolds that gamification offers in learning: motivational scaffolds, cognitive scaffolds, and metacognition scaffolds (Morris et al. 2013). Firstly, the elements of points, rewards, levels, ranking, and challenges lead to a positive change of emotion toward learning such as affection, attitude, feeling, and interests. Furthermore, game-like activities can scaffold a cognitive process by assigning tasks, providing simulation, distributing knowledge, and creating situations. To finish tasks or achieve goals, players need to plan, monitor, and assess their knowledge and skills and to track their learning progress within a systematically controlled gamified context, which is a process of metacognition training.

To increase children's reading motivation, a gamified reading e-quiz platform, Reading Battle (RB), was designed for children in Hong Kong (Chu, 2016). Reading comprehension quizzes ("battles") were developed for around 500 children's literature titles that span different genres. The battles can be accessed through a search of a title, author, book ID, or ISBN, or can be selected from archives that are categorized by genres. Each battle consists of 10 questions and the full score of each battle is 100. Users earn points as they attempt to answer each question and are rewarded with different e-badges for different levels of accomplishments. Top-performing users are recognized by being listed on the leaderboards of the system. The well-designed interface also makes RB an interesting and appealing gamified platform for children. The design of the connection of online gamification and offline reading is based on the assumption that children need to read corresponding printing books before answering the online questions. RB has already been applied in more than 50 primary schools in Hong Kong since 2014.

### Methodology

The research question of this study is: how does the gamified reading platform affect primary students' reading habits, academic performance, reading competency, and reading motivation. To investigate the effects of RB on the above aspects, mixed-method research was applied in this study to gather both quantitative and qualitative data (Creswell & Clark, 2017). First, we collected the quantitative data of the academic year of 2017-2018 from the RB online system. The online system records how students perform in the gamified reading platform, e.g., how many books they read, what is their mean score, etc. Qualitative data were collected from semi-structured interviews, and the target student participants in the interviews are active users of RB. Therefore, the top-20 scorers under the "Last Term Score", "Improvement Score", and "Total Life Score" leaderboards

in the observational academic year, were invited to participate in the study. Finally, 37 students, 20 parents, and 7 teachers were invited to face-to-face interviews conducted during their school lunchtime, each of which lasted for around 20 minutes. The structure of the interview questions consists of four parts: reading habits, academic performance, reading competency and reading motivation.

School	Mean books	Highest reading books	Mean score	Highest total score
School 1	21	274	89	25483
School 2	13	212	83	19609
School 3	12	215	56	10375
School 4	11	148	84	13973
School 5	11	147	79	13973
School 6	11	145	69	13192
School 7	9	261	78	25342
School 8	8	173	62	15033
School 9	4	285	74	25826
School 10	4	122	79	11719

Table 1. Students' performance in RB from top-ten schools

Grade	Mean books	Highest reading books	Mean score	Highest total score
P1	24	274	90	25483
P2	42	248	93	23505
P3	13	68	85	6413
P4	13	69	84	6311
P5	12	107	85	9700
P6	10	122	85	11634

Table 2. Students' RB performance of each grade in one school

Qualitative data were collected from interviews and coded regarding the effects of RB on children's reading behaviors, abilities, and motivation (see Table 3). The participants showed positive feedback regarding the effects of RB on the above items. They reported the process by which RB changed their reading habits such as their reading frequency, initiative, independence, and selection of books. For example, one student (LTM-STU-LCC)<sup>1</sup>, said "after joining RB, I would do more extended reading in related subjects that are interesting". Most of them improved their reading initiative and independence, and they often read voraciously even though they were not instructed to do so.

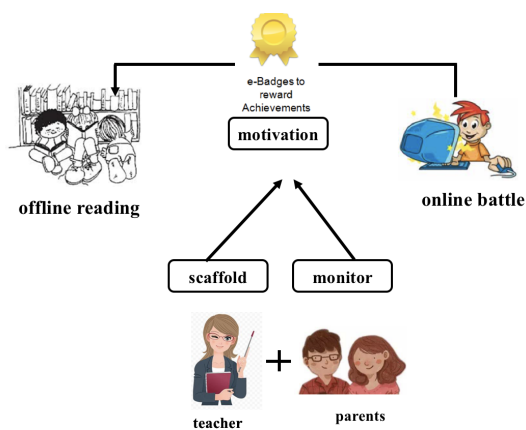
The interviewees suggested that participation in RB helped improve their reading ability in many aspects. Some students reported that they learned more vocabulary as the number of books they read climbed. Their writing also improved due to an accumulation of words, phrases, and ideas that they learned from across the pages, which enriched their writing skills. Furthermore, their reading speed increased after

<sup>1</sup> Referring to the pseudonymous names of participants

having joined the RB, and that enabled them to be more capable of answering questions in their homework assignments or exams. The practice of answering the questions facilitates children’s comprehension skills, which in turn helps them, concentrate on key points in their exams. Ultimately, the participants’ engagement in RB was driven by many motivations which are both intrinsic (e.g., the feelings of challenge, curiosity, and achievement) and extrinsic (e.g., seeking for ranking, badges, and competition).

Theme	Coding example
Reading behavior	<ul style="list-style-type: none"> <li>- In the past, I only read very few books, like 2-3 each week. Now I read 6-7 books each week. (HL-STU-LSC)</li> <li>- My mum used to ask me to read more books, but now she no longer does that because I will read by myself now. (HL-STU-PLC)</li> <li>- I used to read more comic books, but now I will read books with more texts like novels. (HL-STU-LSC)</li> <li>- I read thinner books in the past, but I read thicker books now. (LTM-STU-LHC)</li> </ul>
Reading abilities	<ul style="list-style-type: none"> <li>- I improve my academic performance in Chinese and English writing (LTM-STU-ME).</li> <li>- In the past, I don’t have any question in my mind during reading, but I have some now. (LTM-STU-LHC)</li> <li>- reading more into the feelings and actions of various characters can enable him to conjecture people’s internal states of mind, their thinking, and also their emotion (LTM-STU-TTY).</li> </ul>
Reading motivation	<ul style="list-style-type: none"> <li>- I like reading the books and finding the answers immediately. Since I want to answer the questions right, I am motivated to read the book (HL-STU-LSC).</li> <li>- I am happy with my ranking. (LTM-STU-LHC)</li> <li>- I hope I can catch up with other classmates by reading more English books. (LTM-STU-ME)</li> <li>- In the past, I don’t read the preface of the book, but I read it now as I want to know furthermore about why the author writes the book. (LTM-STU-ME)</li> </ul>

**Table 3. The coding of qualitative data based on the interviews**



**Figure 1. The model of the gamified reading platform**

Also, we did simple statistics of students’ responses to semi-structured interviews. It is demonstrated that 35 out of 37 (95%) students reported that their reading habits had changed in various aspects, especially their reading frequency (68%) and their selection of books (59%). Furthermore, 34 out of 37 (92%) students reported that they made various academic improvements while using RB. Writing is one part that saw considerable improvement, with a self-reported improvement rate of 49% among the students who did well in English writing. It is demonstrated that 68% of students thought that they had improved their general understanding of text after using RB, followed by their interpretation skills (57%). Lastly, 62% of the respondents thought that their active participation in RB owed a great deal to the ranking or leaderboard. The points system came in at 30% as the second extrinsic factor, barely edging out the affordance of battle questions at 27%.

### Discussion

#### *The model of the gamified reading*

The model of the gamified reading in this study motivates children to read offline printing books by providing online “battles”, e-badges, and leaderboard (see Fig.1). According to the practice of RB in Hong Kong, children borrowed books from schools or public libraries to read and then answered the corresponding questions in RB in school computer rooms or at home. Both teachers and parents provided scaffolds for children and monitored them to participate in RB in the schools or at home to make sure they can use the computer appropriately. Even in low-tech areas, what a child need is just a computer or an iPad which connects to the Internet. It was found that some children who cannot access computers at home would finish battles in the school or city public libraries. Table 1 shows the different participation in RB for top-ten schools, which results from the different resources and strategies different schools provided. According to the teachers’ interviews, the key resource to facilitate participation is not computers but the hardcopy books which students can access easily. Although some studies suggest that e-reading can increase readers’ interest (Coiro, 2011), it is unpractical for children to have an entire e-reading especially in low-tech areas (Colombo & Landoni, 2011). Also, many parents have various considerations toward online reading, such as protecting eyes and preventing Internet addiction, so they hope children can come back to offline printing books. Low tech is not equal to no tech (Fontela & White, 2017). Gamified reading e-quiz platform, such as RB, drives young readers to active reading with limited technologies, which is user-friendly for primary students. Before they access an online RB platform to finish battles and get badges, they need to spend much time offline reading. Therefore, it is convenient to implement the model of RB in low-tech areas to help children increase their offline reading interest.

### ***The effects of the gamified reading e-quiz platform***

According to both quantitative and qualitative data, it is suggested that the gamified reading platform can foster students' reading habits, competence, and motivation, providing insights into students' reading skills and progress without putting pressure on the students. Morris et al. (2013) concluded that gamified learning serves students with motivational, cognitive, and metacognition scaffolds, which explains the positive effects of RB in this study. RB has enabled students to enjoy reading and to learn in a gamified manner. The game-like elements of RB include but not are limited to battles, points, ranking, and feedback. Students are attracted to engage in the "battles" produced by these elements and, thus, begin to access more various books. Especially for negative readers, RB renews their feeling toward reading. Furthermore, e-quizzes were designed as gamified cognitive tasks in this study. Students improved more on their understanding and interpretation skills due to the well-designed questions adapted from the PIRLS 2011 assessment framework (Mullis et al., 2009). A consistent trend in the perception of improved reading competency was recorded among the students, parents, and teachers. Finally, as the students were free to choose which books to read and could take e-quizzes with hardly any adult intervention, their participation in RB contributed to their self-regulated learning and metacognitive skills during reading.

### **Conclusion**

This study investigates the effects of the model of RB in fostering children's offline printing reading. The practice of RB in many primary schools in Hong Kong shows that this gamified reading e-quiz platform is welcome to motivate primary students to read, which is low-tech and convenient. Participants reported that the gamified reading platform affects their reading habits, competency, academic achievement, and motivation positively. It is suggested that they were motivated to read more books both extrinsically (e.g., the leaderboard) and intrinsically (e.g., a sense of achievement). The qualitative results cross-validate the quantitative results and give more explanation of how the gamified reading platform affects primary students' reading processes. These findings can help teacher-librarians enhance their strategies of teaching and learning to foster children's reading literacy, even for the children in low-tech areas.

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# Mobile-based Synchronous Q&A for Knowledge Sharing: A case study of Zhihu Live

**Ying TANG**

The University of Hong Kong  
yingtang@connect.hku.hk

**Huixin TIAN**

Indiana University Bloomington  
huixtian@iu.edu

**Noriko HARA**

Indiana University Bloomington  
nhara@indiana.edu

## ABSTRACT

Featured with mobile-based synchronous interaction, Zhihu Live has introduced a new location-free real-time online question and answer experience. This service may bring informal learning opportunities to environments where mobile communication plays a vital role in information exchange. This paper reports on a pilot investigation into this new form of online knowledge sharing. A Zhihu Live case was studied to examine the types of interactions and the host evaluation of the practices and feelings. We collected and analyzed the online interactive records and the semi-structured interview with the host. The results suggested a high level of interaction between the host and audience, and among the audience themselves. Social network analysis results showed that the audiences form their preliminary form of the online community through the social interactions among the audience. The host was overall satisfied with this mutually communicative sharing experience with a lay audience, but the audio message and money incentives brought much pressure. Limitations of the current study and suggestions for future research are discussed.

## Keywords

Zhihu Live, mobile-based, synchronous, audio, online Q&A

## Introduction

Internet is nowadays the dominant source of knowledge and information. Compared to asking an expert in person or going to the library for document search physically, online search facilitates an expedited search and retrieval process with an expanded repository of information. One Internet service that enables ubiquitous informal learning is online question-answering (Q&A). Online Q&A allows users to specify the information need in natural language rather than with phrased key terms, and receive individually tailored answers rather than a list of search engine generated results (Shah, Kitzie, & Choi, 2014). It also provides the opportunity to accumulate wisdom from wide-ranging communities on the Internet. At the same time, users can engage in direct interaction with others. Examples of popular online Q&A platforms include Yahoo! Answers, Quora, Chacha, and Reddit.

Zhihu Live (hereinafter, Live) is a new service getting increasing popularity. It is a mobile-based synchronous Q&A service operated by Zhihu, the largest Q&A site in China with more than 160 million users as of 2017 (Walkthechat, 2018). Instead of adopting the traditional threaded format of online Q&A, where users answer the questions along the thread initiated by the question asker, Live is marketed as a “new real-time interactive Q&A experience”. A Live is presented in a structured format. Typically, the host(s) will first provide some basic information about the topic, time, background information and a brief sharing outline. The audience who decide to participate in the session will pay a small amount of fee to get access (normally 1 to 2 USD). In other words, Lives are not free — host(s) also price the “entrance ticket” before the session starts. Each Live lasts around one hour, during which the host(s) will share their expertise on a central topic, and take questions from the audience and respond in text, picture, audio or video. Users can also “like” a question or a response from the interaction, similar to the Facebook “like” function. Users can join and view the session after it ends, but no live interaction will be available anymore after the host ends the session. Figure 1 shows the information and the interaction pages of two past Live sessions.

Compared to traditional online Q&A, a Live experience is unique in the following aspects. First, it is a mobile-based service, with which the free-bound learning is facilitated. Second, it is synchronous. The host and audience are present and engaged during a particular period. Previous Q&A interaction is mostly asynchronous, with a time lag between when the answer is posted and when the first answer is received. Third, it is multi-modal. Traditional online Q&A tends to be text-based, whereas Live provides more options, including text, picture, audio, and video.

Being a new form of online Q&A, Live showcases the potential to create ubiquitous informal learning opportunities, particularly to the environments where mobile communication plays a vital role in information exchange. However, little is known empirically in the literature about this service. No previous evidence exists regarding how this mobile-facilitated synchronous multimodal communication might influence information exchange and user experience. Therefore, this paper reports a pilot investigation of a Live

case. A mixed-method case study was carried out, based on the three M' framework—the modalities, motivations, and materials, by Shah et al. (2014).

### Related Studies and Theoretical Framework

Lives are hosted by individuals or organizations in possession of the expertise knowledge on specific topics or fields, which characterizes this Q&A service as an expert-based type. Choi, Kitzie and Shah (2012) studied various online Q&A services, and proposed a typology to classify them into four models: 1) Community-based, such as Yahoo! Answers, where people ask questions to the open community and receive personalized answers archived in threads; 2) Collaborative Q&A, such as WikiAnswers, where users collaboratively edit and improve a question/answer to best address the information needs; 3) Expert-based, such as Google Answers, where answers are provided by recognized or self-identified experts rather than an open community, and 4) Social Q&A, such as Facebook and Twitter, where users ask questions to friends or acquaintances within a social network. A substantial body of literature has focused on either the community-based model or the social model (e.g. Harper, Raban, Rafaeli & Konstan, 2008; Hsieh & Counts, 2009; Morris & Teevan, 2012; Liu & Jansen, 2013; Panovich, Miller & Karger, 2012; Paul, Hong & Chi, 2011; Raban & Harper, 2008), whereas much less attention was paid to the expert-based type of Q&A services (Pomerantz, Nicholson, Belanger, & Lankes, 2004).

Additionally, as the dominant mode of interaction is asynchronous, very little is known about synchronous online Q&A. Extant literature suggests a variety of time lags of social Q&A and community Q&A. For instance, Paul et al. (2011) found that more than half of the Twitter questions received the first response within five minutes. Similarly, Morris et al. (2010) reported 94% of the questions received the first responses immediately on Facebook. On the other hand, the waiting time tends to be longer on community Q&A sites. According to Hsieh and Counts (2009), one would have to wait 3 hours on average to receive an answer on the platform of Live QnA by Microsoft. Zhang et al. (2007) reported that the first answer could take as long as 9 hours, especially if it required specific expertise. Unlike the traditional asynchronous mode, Live is designed to be synchronous and interactive. No empirical study has reported how the synchronicity might impact user interactions and perceptions to the best of our knowledge.

Regarding why people are engaged in online Q&A practices, studies reported various types of motivations for people sharing information online. Intrinsic factors include a sense of personal ownership of certain knowledge, self-interest on specific topics, commitment to a social role, simple enjoyment and the sense of being respected and appreciated

(Raban & Harper, 2008; Ling et al. 2005). Extrinsicly, social recognition and monetary compensation were reported as positively related to online Q&A behaviors (Raban & Harper, 2008). However, monetary incentives may bring complexity to the system. For example, Jan, Wang, Zhang and Wang (2017) studied a payment-based community Q&A system Fenda, and reported that users would game the system and strategically adjust the price to make profits; some experts were unwilling to lower prices which might inhibit user engagement. However, previous studies mainly examined why people are willing to pay for knowledge sharing (such as Liu & Feng, 2018). Little evidence has examined why and how the monetary incentives might influence the hosts' perception and behaviors in these online activities.

This study presents one of the first investigations into this expert-based mobile synchronous multimodal Q&A experience. It is guided by the three M's framework (Shah et al., 2014) to examine online Q&A from a holistic viewpoint, taking into consideration users, services and content. As shown in Figure 2, this framework consists of three interactive aspects: modalities, motivations, and materials. Modalities mainly inspect the service, about where and how people exchange and use information; motivations address the user intentions and expectations of adopting online Q&A services; materials examine the content being generated within these sites (Shah et al., 2014). Accordingly, the following questions are crafted to guide this study:

- What types of interactions were people engaged in the Live?
- What sources and strategies did the host use to engage audience in the Live?
- How would the host evaluate the experience of conducting the Live?

### Methodology

We adopted a mixed-method case study design (Yin, 2008) to gain an in-depth understanding of what was happening, prioritizing qualitative methods because of the exploratory nature of the research questions. The case was sampled because of the host approachability. This Live was titled "What is archeology and what do archeologists do?" It was scheduled at 10 pm, July 27, 2016, and priced at 12.9 in Chinese Yuan (equivalent to around 2 US dollars). On the information page, the host provided a brief introduction to herself, the purpose of the session, and a list of six topics to be covered, namely what archeology is, what archeologists are doing on the daily basis, whether media products have

authentically portrayed archeology and archeologists, the challenges faced by archeologists, and how to apply for a degree in archeology and relevant fields. By the time we finished data collection (2018/09/21), the session has attracted 365 participants.

### **Data collection**

Two main data sources were included: users' online interactive records of 366 participants including the host, and a semi-structured interview with the host. The interactive records were retrieved directly from the online database. The host participated in the semi-structured interview not only as of the interviewee but also as a researcher. Therefore, the interview data are responsive and reflexive. The main foci of the interview questions included: Why did you choose Zhihu Live as the sharing platform? How did you prepare for this session? What strategies did you take to engage the audience? How would you evaluate this experience? How was the experience compared to face-to-face or asynchronous information sharing? What was the role of monetary incentives in this process? If you were to host a Live again, what changes would you make? The interaction and interview records were transcribed for further analysis.

### **Data analysis**

First, content analysis was conducted to identify the types of interactions happening in the session. As no extant study examined a synchronous online Q&A session, previous coding schemes could not fully capture the interaction patterns manifested in the data. Therefore, we adopted the open coded analysis approach based on grounded theory (Glaser & Strauss, 1967). We first differentiated the messages sent by the host and audience and examined the forms and intentions of each message. The initial coding scheme was created, assessed and revised through a reiterative process until no new codes would emerge. The final coding scheme is shown in Table 1. One researcher independently coded the code, and 50 were randomly sampled and coded by another researcher for the interrater-reliability check. The initial agreement rate was 94%, and all disagreement was resolved through discussion until consensus was reached.

Second, we coded the sender and intended receiver of the interactions and conducted a basic social network analysis, in order to understand the structure of the network. Social network analysis is a methodology used to explore the patterns of interaction within the network and to present the network structure graphically. We used the statistical computing tool, R, to draw the social network relationship graphic and visualize the networking activities during the session.

### **Results**

Among a total of 284 messages being generated, 237(83%) were produced by the audience, while the other 47 (17%) were from the host. In terms of media format, 253 (89%) of the messages were in the text, and 31(11%) were in audio—all generated by the host. Regarding the timing, the formal session lasted for two hours. 64 (23%) posts were left by the audience prior to the scheduled Live, while another 7 (2%) posts were generated after the session by the host. The rest, 213 (75%) posts, were produced during the session. Table 2 summarizes the distribution of posts by the contributor, format, and timing. Additionally, like “liking” being another indicator of interaction, 708 “likes” were received by 187 posts, aver-aging 3.8 likes per message. The host received 236 for her 45 posts, with an average of 5.2 likes per message.

### **What types of interactions were people engaged in?**

Out of the 47 host posts, 11(23.4%) were to manage the flow of the interaction. One example was the host asked the audience, “Can anybody hear me clearly by far?” or indicated a topic shift, “I’ve covered the six question listed in the outline. Now I will answer some questions you posted in advance”. 26 (55.3%) was to deliver the prepared content, including addressing outlined topics (n=19) and answering prepared questions (n=7). 10 (21.3%) were to answer participants’ questions spontaneously without preparation. Table 3 summarizes the results.

To understand what was discussed by the participants, we coded audience interaction. The results revealed that among the 237 posts, posts about questioning (n=90, 38%) and responding (n=91, 38%) were the top two categories, followed by socializing posts (n=44, 19%) and providing suggestions (n=7, 3%).

The contents were further analyzed in terms of what the posts were about. Out of the 90 questions, most were asked about factual information (n=57, 24%), such as “Is there a research center about dinosaurs in China?” Under the category of responding, the top sub-topic was commenting on peer responses (n=35, 15%) and provide answers or help (n=33, 14%). For example, when somebody referred to tomb looting as a profitable occupation, a user refuted straightforwardly, “We are talking about archeology, not looting.” In socialization posts, the top subcategory was to express appreciation to the host. 7 posts were about providing suggestions to improve the overall experience, such as “can each audio message be shorter?” Table 4 summarizes the number and percentage of each subcategory, and figure 3 visually displays the results.

The host and audiences constructed a network of social interactions in their participation, as visualized in Figure 4. Each circle represents a numbered user (0 representing the host), and the interactions were illustrated with arrowed lines. The arrow indicates the direction of each interaction. Figure 4 clearly illustrated that besides the social networking

through interactions between the host and audiences, the audience also actively formed a social network with several core individuals (e.g., 22, 23, 28, 34, and 35), who were connected most frequently with other participants, through mutual interactions that do not necessarily involve the host.

### ***What sources and strategies did the host use to engage audience?***

Answers to this question have implications for the “modalities” aspect of the three M’s framework. Specifically, Modalities examine where and how people exchange and use information. What is special about Live that invites the host to share information on the site and the audience looks for information with this service. First, Live showcases a typical step-by-step setup. The audience first left questions in advance, then the host delivered prepared content while allowed improvised questions during the session, and afterward answered questions. In the interview, we were interested in what resources and strategies the host had utilized to prepare the session and engage the audience and why she had chosen Live as the sharing platform. The results indicated that this form of communication helped her understand the audience’s interest by reviewing the questions they left in advance, and be able to communicate the knowledge with focuses, striking a nice balance between the host intention and the participant expectation.

Additionally, the procedural setup provided an organized two-way communicative channel. Unlike a unidirectional lecturing, the interactivity and relatedness helped the host engage the audience. Previous literature suggests that the quality of online Q&A services is usually evaluated in two-fold: user-based and content-based (Shah et al. 2014), and Live seems to well represent both aspects.

Live is an expert-based sharing. It allows the outsiders to get opportunities to have first-hand insights from an expert in a mutual communicative process. The host explained why she chose Live. “Archaeology was a small and low-profile area. I thought introducing an area that remained a little mysterious to the public would be fun. I identified myself as an insider in the archaeology community sharing knowledge to the outsiders, in a non-serious teaching-learning situation.” The host considered this environment a non-academic informative session, aiming to make knowledge that was otherwise obscure accessible to the general public. This viewpoint corroborates Lichtenstein and Hunter’s (2005) idea that the information seekers’ interest in learning acts as a strong motivator for sharing knowledge

As for the resources, because Live was not free, the author had to provide an outline appealing enough to attract the audience and kept the content structured, professional and rich enough to maintain the quality. She thought the outline and questions from the audience were particularly helpful

with her preparation. “I took the chance to think about what to include in the talk. I listed a few topics, wrote a brief introduction, and posted them out. I even borrowed a picture taken by my college cohort and used it as the cover image. I didn’t like to memorize materials... I wrote one paragraph for each topic, like a cue, to warm myself up to talk more.”

To the host, Live seems to be naturally engaging, mainly because of audience passion and the interactivity. People paid for it because they were interested in the topic, and the Q&A format ensured a level of interactivity. The host commented, “I didn’t have many tricks to engage the audience. Archaeology was a heated topic in mass media products (novel, movie, or TV shows) then, which might have contributed to the popularity of this Live. The audience was much more active than I ever expected...I placed some of their questions among the prepared content and answered their questions after finishing the prepared parts. I think this is the best way to keep the interactions alive.”

### ***How would the host evaluate the experience?***

On the one hand, the host was satisfied with the overall experience. She was able to deliver what she had prepared and kept the audience engaged. She also enjoyed the opportunity to freely express her individual opinions, which was not common in her daily researcher role. “I did achieve the goal of sharing a live life of an archaeologist, with the joy of sharing insider knowledge. It’s not as strict as publishing a paper. You can talk about your real-life and personal opinions. I tried to keep it as an opinion-oriented narrative, rather than pretending to be an expert holding the privilege of inside knowledge.”

She also enjoyed the interactions among the audience. They were passionate not only in socializing, but also building rapport and sharing knowledge. “Some of my audience pointed out that tomb looting was damaging in nature to archaeological fieldwork, so archaeologists may feel offended if you compared them with looters.”

On the other hand, constant interaction and audio sharing brought much pressure to the host. “The constant interaction brought more stress, the same as a face-to-face conversation. Not showing my face reduced a little anxiety, but I was still nervous about exposing my voice. I intentionally slowed down my speaking speed. I speak fast when I was nervous. I was always afraid that people didn’t enjoy the talk. I’d rather type.” According to the literature, when the anxiety levels of the voice-chat group and the text-chat group were compared, only the latter showed a decrease in the anxiety levels (Satar & Özdener, 2008). The synchronicity leaves the host with barely any time to reflect and revise the message before it is delivered to the audience; thereby it creates higher levels of stress and anxiety.

The money incentive also created anxiety. The host had to constantly reflect on whether what she offered was worth the

cost. In addition, to overtly price knowledge seems awkward for the host, as she considered knowledge is not priceable. "People normally pay for a learning program, but it is more like a maintenance or membership fee, and teachers get paid by the organization. The fee is not directly associated with the person who shares the knowledge. This (Live) does not feel comfortable and right. Actually, I'd rather host the session for free."

When being asked if she was willing to host another Live, the host expressed the reluctance to have another live sharing. First, she did not like the insecure feeling brought with possibly revealing personal traits (voice). Compared to textual information, audio sharing was attached to a higher level of possible personal identification. "I'm an introvert person. Even though no one can really identify me by my voice, it still feels too intimate." Another factor was the difficulty to refine or edit the audio message, which may negatively impact the accuracy of information transmission. "Audio sharing is not the most effective form of sharing knowledge. I had to send a follow-up message to correct if I made any errors in the previous voice thread."

### **Discussion and Conclusion**

The article reports the first empirical exploration of an innovative form of online Q&A, which is mobile, synchronous, paid, expert-based and audio-facilitated. We referred to the three M's framework by Shah et al., (2014) and conducted a mixed-method case study, primarily based on the online interactive records and a semi-interview with the host. The main contributions of this study lie in the following aspects. First, a coding framework was developed to study the types of interactions in this synchronous Q&A session. The results indicate that mutual communicative opportunities were created between the expert and the audience; there also existed a high level of interaction among participants themselves, suggesting the formation of a community of interest where users could collaboratively share and construct knowledge. Second, we analyzed and presented the network structure of user interaction. As expected, the host played the central role, but it is interesting to see that the audience also actively formed a network among themselves with several core individuals, without involving the host. Third, the host was appreciative of the opportunity to communicate directly with the audience about the topic of her passion and major. She felt free to express her individual opinions in a narrative way, compared to writing an academic research paper. However, the audio sharing and the money incentive created a lot of pressure. She was bothered by the exposure of her voice (too intimate) and the obligation to make the sharing worth of the cost. Even though the audience seemed to enjoy this experience, she was hesitant to host another Live session.

The study takes a preliminary step of looking into the features, and reveals the merits and drawbacks of this

mobile-based synchronous Q&A, as a new form of online knowledge sharing. Many questions still remain to be answered. Our first question is about audience perspectives. First, while we know from this study that an online community of audiences emerged from their interactions, not only with the host but also with each other, we do not know the detailed and dynamic process of how their social interactions construct the preliminary form of the community. In addition, how do they perceive the experience? One limitation of the current study is we were not able to collect data from the audience due to some logistic reasons. We are very interested to see how the audience would evaluate their Live participation and interaction. The interaction records in this study seem to suggest that the audience was actively engaged, but we would benefit from getting more direct and subjective evidence about user attitude. As a single-case study, this research suffers from the generalizability issue. Therefore, more studies are definitely needed to further our understanding of this online behavior. This Live was one of the pioneering sessions held in 2016 when the service just launched. Future studies should examine more recent sessions to see if there are any updates of the service feature if there are any changing behaviors of the audience as they are perhaps getting used to the service and if there are any differences if a broader coverage of topics is examined.

Category		Definition and example
Host		
<b>HM:</b> Managing the flow		A post that manages the flow of sharing, like “the session is about to start.”
<b>HP:</b> Delivering prepared content		A post that contains prepared content.
<b>HU:</b> Delivering unprepared content		A post that contains unprepared content.
Audience		
Questioning:	<b>QF:</b> Seeking factual information	The answer is fact-based and can be backed up with references. “Is Peking U the only one in China that has archeology majors?”
	<b>QO:</b> Seeking opinions	The answer is based on personal belief or view. “Do you think girls can handle archeological excavation?”
	<b>QA:</b> Seeking advice or recommendation	The answer is to provide resources or advice on a topic. “Could you recommend some archeological reports for lay people?”
	<b>QOT:</b> Other	The answer is not directly relevant to the content. “It is a little stuck. Is it because of my internet speed?” (technological difficulty)
Responding	<b>RA:</b> Adding information	A post that adds information to one’s own previous post. “There are some entry-levels books.” “Zhang Guangzhi’s are good.”
	<b>RCH:</b> Commenting on host’s posts	A post that responds to the host. “I love the analogy!”
	<b>RH:</b> Providing help or answers	A post that provides answers or help. “What books can a complete layperson read?” “Take an online course.”
	<b>RCO:</b> Commenting on others’ posts	A post that responds to other audience. “National geography has harshly criticized it.” “They are not professional.”
	<b>RQ:</b> Asking follow-up questions	A post that asks a follow-up question based on a previous one. “I see. What will happen after that?”
Socializing:	<b>SG:</b> Greeting	A greeting expression like “Hello”.
	<b>SA:</b> Appreciation	An appreciative expression like “Thank you”.
	<b>SD:</b> Disclosing personal experience or feelings	A post that reveals one’s past experience or feelings. “I am always interested in archeology”.
	<b>SP:</b> Presence	A post that indicates one’s presence. “Waiting quietly.”
	<b>SS:</b> Supporting	An encouraging and friendly post. “This talk has been done very well.”
Providing suggestions		A post that provides suggestions. “Shall we have a WeChat group for more sharing?”
Other		A post that cannot be coded, such as a question mark with no other textual information.

**Table 1. Coding scheme of interaction types**

	Contributor		Format of the message			Time of posting	
	Host	Audience	Text	Audio	Before	During	After
N	47	237	253	31	64	213	7
%	17%	83%	89%	11%	23%	75%	2%

**Table 2. Distribution of posts by contributor, format and timing**

	Managing the flow	Delivering prepared content	Delivering unprepared content
Frequency	11	26	10
Percentage	23.4%	55.3%	21.3%
Format	Audio (n=1) & Text (n=10)	Audio (n=26)	Audio (n=4) & Text (n=6)

**Table 3. Type of host posts**

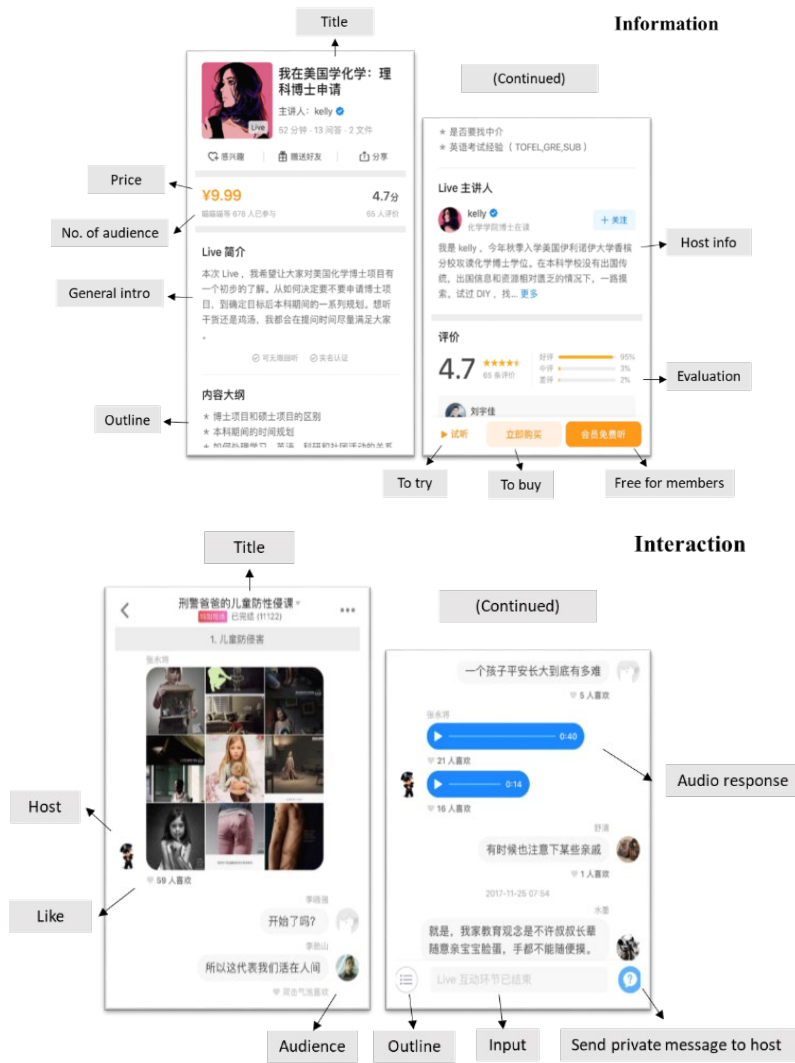


Figure 1. Examples of the information page and interactive page of Lives

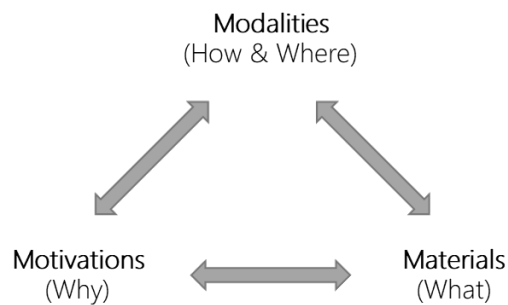


Figure 2. The three M's theoretical framework (adapted from Shah et al., 2014)

	Q (n=90, 38%)				R (n=91, 38%)					S (n=44, 19%)					P	OT	Total
	QF	QO	QA	QOT	RA	RCH	RH	RCO	RQ	SG	SA	SD	SP	SS			
N	57	18	10	5	10	10	33	35	3	5	17	8	4	10	7	5	237
%	24%	8%	4%	2%	4%	4%	14%	15%	1%	2%	7%	3%	2%	4%	3%	2%	100%

Table 4. Type of audience posts

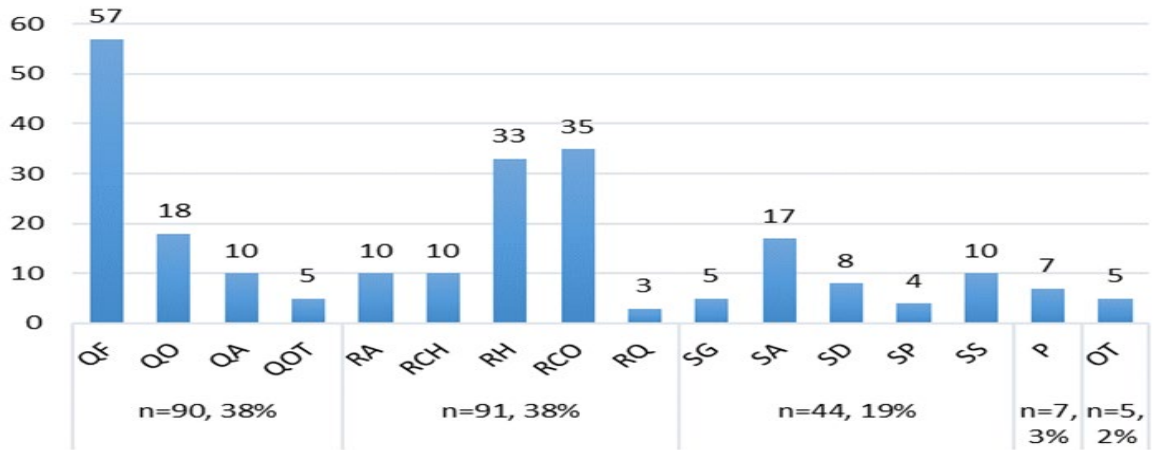


Figure 3. Frequency of posts by types of interaction

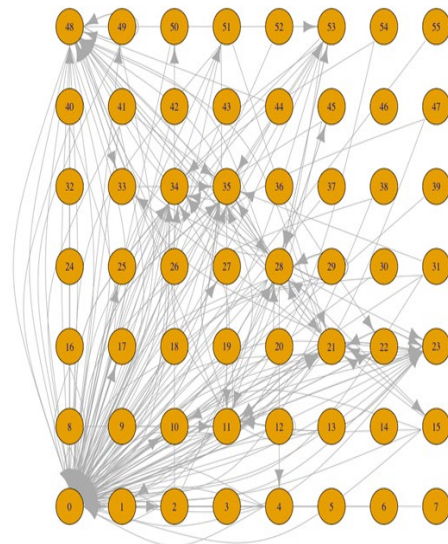


Figure 4. Network of social interactions of users



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# Game based learning through digital and non-digital approaches: Developing English phonemic awareness

Teresa Chu

The University of Hong Kong,

Hong Kong

c.teresa.hk@gmail.com

## ABSTRACT

In recent years, game-based learning has gained attention in educational research and become a focus in literature. This experimental project, conducted in an early primary classroom, investigated the effectiveness of applying a traditional pedagogical strategy, immediate elaborate feedback, from the in-class teacher to two different types of game-based learning modes, digital and non-digital game-based learning. A mixed-methods design applying both quantitative and qualitative methods was utilized. To assess student improvement in English phonemic awareness, the results of quantitative data collected through the administration of pre- and post-tests were compared. Qualitative analysis of in-class observations and teacher questionnaires was applied to evaluate students' engagement. Analyses indicated that game-based learning approaches, digital and non-digital, when followed with immediate elaborate feedback are effective in facilitating young students' engagement and enhancing academic learning in English phonemic awareness.

## Keywords

Mixed methods, game-based learning, digital game-based learning, non-digital game-based learning, immediate elaborate feedback, English phonemic awareness

## Introduction

Game-based learning (GBL) mechanisms have become an increasingly important vehicle for educational interventions (Clark, et al., 2015; Prensky, 2005; Van Eck, 2006). As we advance into the fourth industrial revolution (4IR), there has been a growing trend to capitalize the use of technological resources harnessing a new form of GBL from digital game-based learning (NDGBL) to digital game-based learning (DGBL) (Clark et al., 2015; Shute & Ke, 2012).

DGBL approaches have been shown to create a more entertaining, engaging and student-centered climate for students to experience play while influencing learning in different disciplines such as Language Arts, Mathematics, Science and Psychology (Chu et al., 2015; Kiili, 2005). On the other hand, even though NDGBL is a less attractive teaching approach, it is a well-established pedagogical method (Gorman, 2015; Van Eck, 2006) and plausibly more

useful for educational purposes.

In 2006, the Hong Kong government recognized and advocated the theme "learning through play" as a central pedagogy for pre-primary education (Curriculum Development Council, 2006), stating that play was "an indispensable and important tool to facilitate children's learning" (p.51). Characteristics of GBL seem to be a promising approach for fostering and engaging students' learning in various domains in local settings (Chu et al., 2015).

## Problem

Through applying a mixed-method design with quantitative and qualitative approaches, a strategy was constructed to explore the effectiveness of GBL (DGBL and NDGBL), when combined with timely and appropriate feedback. Quantitative measures employing pre-test and post-test were used to measure gains in students' learning achievement while qualitative applications captured and describe students' engagement.

## Research question

The study aimed at investigating the effects and exploring the potential use of GBL for young learners and answering the following research question: Does GBL (DGBL and NDGBL) influence students' engagement and affect their learning achievement when followed by immediate elaborate feedback?

## Literature review

### *Game-based learning*

Learners of all ages, especially children, develop socially and intellectually through playing. Shute and Ke (2012) stated that game-based environments for learning are "interactive, provide ongoing feedback, grab and sustain attention, and have appropriate and adaptive levels of challenge" (p.1). Thus, it seems to be beneficial for educational practice and learning experiences as it combines fun elements with aspects of instructional design. There are two main categories of GBL, namely, digital game-based learning (DGBL) and non-digital game-based learning (NDGBL).

DGBL is slowly becoming a much more developed and modern form of GBL (Van Eck, 2006) involving an increased number of research projects and publications in recent years (Prensky, 2005; Kiili, 2005). It is often preferred over traditional media, for example, textbooks or non-digital game-based learning (NDGBL) forms and has been proven to be an effective mode of capturing young learners' attention (Clark et al., 2015).

NDGBL encompasses numerous types of physical, board and card game-based learning, and has long been established in the formal educational practices in various disciplines (Gorman, 2015; Van Eck, 2006). Implementation of NDGBL is not as sophisticated as DGBL but poses fewer logistical challenges, for example, potential technical issues and unreliable access to internet connections, while still positively affecting educational delivery (Van Eck, 2006).

### **Feedback**

As stated by Hattie and Timperley (2007), feedback is one of the most critical aspects of education in enhancing students' knowledge or skills on the taught topic. According to Raymond Kulhavy (1977), there are different levels of constructive feedback, namely 1) knowledge of results (KR), 2) knowledge of correct response (KCR) and 3) elaborated feedback (EF). KR feedback simply informs learners if their answers are correct or incorrect; the correct answer is not provided. KCR feedback additionally reveals correct answers. EF feedback is richer in that detailed information or clues are provided to guide learners to understand the correct answer.

### **English Phonemic Awareness**

Phonemes are the smallest units comprising spoken languages. 41 English phonemes blend to form syllables and words. According to Liberman et al (1974), phonemic awareness refers to ones' detection abilities to focus on and manipulate phonemes in spoken words represented by letters. For instance, the word 'bat' has three phonemes, /b/ /a/ /t/.

In Hong Kong, most young Chinese English second language learners (ESL) or foreign language learners (EFL) studying phonemic awareness find it somewhat confusing and stressful as they have very little exposure in their early years (Hung, Young & Lin, 2015). To remedy this problem, game-based learning activities involving DGBL and NDGBL were introduced in this project study to increase student engagement and learning achievement.

### **Methodology**

#### **Site and Participants**

The selected school is a local Hong Kong Chinese medium government-aided primary school in Sha Tin district. A majority of students learn English as a second or foreign language. A total of 132 students were invited from five

primary one classes forming case A (N=22), case B (N=23), case C (N=20), case D (N=24) and case E (N=26). Students in each case had different levels of phonemic awareness abilities; thus, they were divided into five case studies. Seven students chose not to participate in the experiment. Data from 10 participants were dropped due to their failure to complete all sessions. The local English teachers of the different cases present during the treatment filled out questionnaires after the experimental implementation.

### **Research Design**

There were four treatment groups (DGBL, DGBL with immediate elaborate feedback, NDGBL, and NDGBL with immediate elaborate feedback) applied over five weeks of experimental study. Each treatment session was approximately 35-minutes and contained a traditional teaching method through the use of PowerPoint presentations. This was followed by the four treatments in which all cases were randomized into different GBL treatments. Case A and D experienced DGBL with immediate elaborate feedback; Case B experienced DGBL; Case C experienced NDGBL with immediate elaborate feedback; Case E experienced NDGBL.

### **Game-based learning tools**

DGBL: Kahoot game skill and mechanics

The experiment used the game-based platform called Kahoot. Students were required to listen to the phonemic sounds, and then choose an answer by simply tapping a color- and shape- coded response on an iPad (tablet) device as quickly as possible.

NDGBL: Printed words and Flyswatter

Students listened to the phonemic sounds, looked at three different collections of letter choices, and selected an answer. A student was chosen from a group of volunteers and given a flyswatter to choose what s/he believed was correct.

### **Data Collection Instrument**

When collecting data in a case study, multiple sources of data across time could be utilized to triangulate the data (Creswell & Creswell, 2018). Thus, in this research project, three more valid and reliable instruments were used, 1) to analyze students' pre-test and post-test results, 2) to observe students' engagement, and 3) to conduct teacher questionnaires.

#### **Pre-test and post-test**

Questions in pre-tests and post-tests constructed by the researcher were identical to explore the effects of different GBL approaches. Students completed the pre-test in week 1, before the treatment phase, and the post-test in week 5, after the treatment phase. Students' performances were evaluated based on their progress and learning outcomes.

### *Observations and Teacher Questionnaire*

Observations serve a formidable purpose as they “provide a firsthand encounter with the phenomenon of interest rather than a second-hand account of the world obtained in an interview” (Merriam, 1998, p. 94). Observers followed and filled in a structured observation protocol adapted from another similar GBL research (Alqurashi, 2016) from week 1 to week 5. Further data on students’ engagement and learning achievement was obtained through a standardized teacher (n=5) questionnaire consisting of 18 questions on a 5-point scale, adapted from ‘Likert Scale Responses for Teacher’ (Alqurashi, 2016).

### **Results**

#### *The Pre-test and Post-test*

The Wilcoxon signed-rank test was used to examine students’ pre-test and post-test results in each case. The results of the post-test were significantly higher in the case of C (SD= 2.50, p= 0.005) and case D (SD= 1.35, p= 0.022) in comparison to the pre-test score. However, the post-test performance of case A (SD= 1.74, p= 0.335), case B (SD= 2.49, p= 0.991) and case E (SD= 2.12, p= 0.800) showed no significant difference from pre-test results as shown in Table 1.

#### *Observations and Teacher Questionnaire*

The informal information gathered for case B (DGBL), C (NDGBL with immediate elaborate feedback) and D (DGBL with immediate elaborate feedback) indicated students displayed higher levels of excitement, greater responsiveness, and adherence to classroom rules while playing. Students in cases with the DGBL approach were all eager to check their scores after each round. Case A (DGBL with immediate elaborate feedback) and E (NDGBL) appeared less attentive and demonstrated higher levels of disruption and non-compliance with classroom rules while answering the questions in the GBL approaches. Finally, all GBL approaches exhibited engagement in the game and adhered to defined practices in answering questions.

The teacher questionnaire yielded a positive response to the use of GBL (DGBL and NDGBL) approaches adopted in regular classroom settings. The findings showed that teachers generally found students more engaged and entertained and that students’ learning achievement was positively affected. Moreover, the questionnaires revealed that the presence and elaborated feedback of the in-class teacher was considered indispensable in assisting students during the game.

### **Discussion and conclusion**

The conclusions deduced from the observations indicated that cases that involved more engagement and adhered to

class-room rules during the GBL approaches were more likely to be successful in achieving learning outcomes. This is consistent with other studies that have found engagement to be highly associated with the students’ success in learning (Hattie and Timperley, 2007; Kiili, 2005). Students involved in GBL approaches that received immediate elaborated feedback by the in-class teacher showed significant improvement. This conclusion is in line with the results of the meta-analysis carried out by Wouters, et al. (2013), exhibiting feedback ( $d = .49$ ) as effective instructional support during GBL approaches.

Conversely, the effect size of case A (DGBL with immediate elaborate feedback), did not show a significant difference from pre-test to post-test. Plausible speculation could attribute this to the lack of students’ self-regulated learning behaviors as described in the correlated data in the class observations and teacher questionnaire. As stated by Hattie and Timperley (2007), self-regulated behavior “involves interplay between commitment, control, and confidence” (p. 93). Students in case A were viewed as in need of more external intervention; being given immediate elaborated feedback would have affected their overall learning. Immediate elaborate feedback can produce large effects on student’s learning and motivation but is dependent upon the student’s attention and ability as indicated by Burgers et al., (2015). One promising solution could be to practice and model positive desired behavior to support students’ cognitive processes. For example, work by Narciss and colleagues found that students were more efficient problem solvers after being given rippled verification feedback the second time after elaborate feedback in the first round (Narciss et al., 2014). Thus, to explore better learning outcomes, GBL approaches could be repeated by providing verification feedback a second time that would mitigate students’ disengagement.

Overall these results seem to support findings of renowned scholars like Piaget (1962) and Vygotsky (1978) and are corroborated by more recent studies (Hung, Young & Lin, 2015; Kiili, 2005) on the use of games in educational contexts. Specifically, GBL contributes to student engagement and increased learning achievements. The study suggests that DGBL and NGBL can influence students’ engagement and positively affect their learning achievement when followed by immediate elaborate feedback. Although in some cases students’ learning achievement may not have been significantly improved, teacher questionnaire and class observations consistently indicated high levels of student engagement and enjoyment. The friendly gaming atmosphere and focused practice were viewed as facilitating an enriched learning environment in which attainment of learning objectives could be more readily achieved. In conclusion, this research study illustrates that young learners can learn effectively through the employment of game-based learning approaches (digital and non-digital) games which

offer valuable platforms for promoting engagement and learning outcomes.

	Cases				
	A (n=22)	B (n=23)	C (n=20)	D n=24	E n=26
Pre-test (M)	9.22	8.30	8.1	10.04	8.88
Pre-test (SD)	1.74	2.49	2.36	1.33	2.12
Post-test mean	9.59	6.96	9.5	10.58	8.96
Post-test (SD)	1.22	3.10	2.50	1.35	2.42
Difference	0.4	-1.3	1.3	0.58	0.16
P-value	0.335	0.991	0.005	0.022	0.800

**Table 1. Overview of students' pre-test and post-test results: Number of students, means, standard deviation, difference and effect size for each case. The Non-Parametric test, Wilcoxon Signed Rank Test**

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# Significance of discussion facilities in collaborative problem solving

Mei Wa Esther WOO  
The University of Hong Kong,  
People's Republic of China  
esther.woo@hku.hk

## ABSTRACT

This paper reported the results of a study in an Asian university about the impact of discussion facilities on group learning behaviors and learning outcomes. Qualitative data were collected through nine observations and ten semi-structured interviews of 13 subject groups. A set of developmental progressions for social skills and cognitive skills for collaborative problem solving (CPS) was adopted to explore whether the environment and facilities of discussion rooms in informal learning spaces such as learning commons and libraries have any significant impact on the learning activities and learning outcomes of students. The findings revealed that good acoustics, appropriate setup of furniture, efficient WiFi coverage, and simple visual display like whiteboards were the most critical factors that render groups affordance in conducting learning activities. These factors were found to be contributing to CPS in particular for group interaction, negotiation, organization in problem analysis, collection of elements of information, as well as representation and formulation of the relationship of knowledge.

## Keywords

Group learning, learning environment, collaborative problem solving, visual display

## Introduction

In the 1990s, the United Nations Educational, Scientific and Cultural Organization (UNESCO) called for a renewal of education in the 21st century to prepare for the transformation of local communities into a world society where human being needs to learn to live together under increasing competition and tension. At that time, it had already been pointed out that many challenges and issues arising from this global development would have to be addressed by continuous efforts in personal development and relationship building (UNESCO, 1996). Many tasks in the 21st century are characterized by their open-mindedness, involvement of unbounded sets of information, and ongoing redefinition of the task goal. Students should, therefore, develop skills in adapting goals based on available

information, seeking as well as evaluating information for their tasks, and continuous monitoring of progress. It is under such a context that collaborative problem solving (CPS) becomes a critical skill set in the educational setting and the workforce. Spaces that facilitate learning activities involving CPS thus become a concern for educational institutes.

## Assessment of spaces for collaborative problem solving

Traditionally, classrooms are treated as the central place of formal learning on campus. With the advancement in pedagogy and technology, mobile learning and ubiquitous learning have enabled learning to take place outside the classrooms (Dumont & Istance, 2010; Shih, Chu, Hwang, & Kinshuk, 2011). The literature has indicated a growing recognition of informal learning through re-thinking the design of non-classroom spaces such as libraries, dormitories, lounges, hallways and catering facilities (Jamieson, 2009, 2013). Research interest has also shifted from formal learning spaces to those for informal and social learning (Boys, 2011).

Many informal learning spaces have now incorporated open or closed spaces as default facilities to cater for group work. However, CPS should not be simply treated as equivalent to group work. In effective CPS, all individuals contribute their resources to the process and rely on each other to put forward information and resources for the common goal of solving a problem. Collective consent on the process and the solution is also an important criterion for CPS. The assessment of CPS tasks must, therefore, focus on both the process and solution or outcome (Griffin & Care, 2015).

In recent years, the idea of learning as a social process has given rise to cross-disciplinary research of learning spaces in the fields of education and architecture. Most of such discussion referred to constructivist approaches and construe learning as both an intellectual process and a collaborative activity (Jamieson, 2009; Sullivan, 2010). However, there is a scarcity of research on how group members develop and apply collaborative skills during the problem-solving process in learning spaces with the aid of their support facilities and services. The purposes of the current study

were to find out how university students interact with the facilities and fellow students, and their perceptions about the impact of discussion rooms on their learning, in particular, the development and application of CPS skills.

### Methods and results

For the sake of validity, the current study adopted a set of empirically validated developmental progressions of cognitive skills and social skills for CPS established by the Assessment and Teaching of Twenty-First Century Skills Project (ATC21S) (Griffin, Care, & McGaw, 2012) to analyze group activities of university students. The cognitive skills are namely “task regulation” and “learning and knowledge building” whereas the social skills are comprised of “participation”, “perspective-taking”, and “social regulation”. All these skills are further subdivided into several elements with specific indicators to facilitate the interpretation and application of the tool. The research site was a university in Hong Kong offering a comprehensive spectrum of disciplines for both undergraduate and postgraduate students. Non-local students (including students from Mainland China, other Asian countries, Australia, New Zealand, Africa, America, and Europe) constituted 25% of the undergraduate and 50% of the graduate student population.

During the creation of the observation checklist and interview protocol for the groups, the two developmental progressions for social and cognitive skills for CPS mentioned above were integrated into the research instruments as a guiding framework to analyze the activities observed and students’ comments on the impact of group learning facilities on CPS. As the skills identified in the above developmental progressions are measurable, theoretically derived and have been validated through large scale assessment data (Hesse, Care, Buder, Sassenberg, & Griffin, 2015), it was believed that they could serve as a useful tool in analyzing the development and application of CPS skills among students in the LC context.

Apart from some basic furniture items such as a large table and several chairs and an ordinary to high level of acoustics, many discussion rooms of the research site were equipped with electronic and/or manual whiteboards, a projection system that could be connected to users’ laptops or the computers provided in the learning commons and libraries. A total of 13 groups with two to 10 members were invited to participate in this research, three of them were referred by fellow students who attended a previous study conducted by the researcher while the others were convenient samples from various sites with discussion room facilities on three campuses of the same university. Samples from all ten faculties except Dentistry were collected. Qualitative data appeared to reach saturation after nine observations (Total=442 minutes) and ten interviews (Total=276 minutes).

Table 1 summarized the major purposes and averaged duration of visit to discussion rooms for each group. The visits, ranging from one to ten hours each time, are mostly related to academic purposes like group projects, class assignments, and presentations. Some groups also used the facilities for extracurricular activities and revision. As reflected by the facilities and mobile devices used, basic technology like WiFi and laptops were almost a must to group activities. As a result, power sockets were often required to recharge the mobile devices of students.

During the interviews, a majority of the students expressed satisfaction with the basic provision of an isolated space plus efficient network connection and power supply. The formal setting, reservation requirement and acoustics of discussion rooms in LC were mentioned as favorable qualities that helped to engage users in terms of punctuality, commitment, and concentration.

“...it’s like when we meet we need an atmosphere to be like official or formal. The same like for study, if you study outside like Delifrance (food outlet) you can be like no mood. It’s very casual.” (G6)

A few interviewees also recaptured their attempt to enhance group works or learning experience by engaging more technology such as using an electronic whiteboard. Some students shared experience with the use of manual and electronic whiteboards, highlighting some factors that deserved attention from facility planners. For example, students with a technology background such as G8 (Engineering) tend to find the e-whiteboards useful. However, other students were not enthusiastic in using this piece of equipment due to its relatively low user-friendliness as commented by some subject groups:

“It is very hard to use...This is extremely confusing... I tried that as well...After using it once, I find it cumbersome to use and therefore stop using it...I spent 15 to 20 minutes to explore the use of the board. I clicked on each specified spot on the board and calibrate its position. (G1)

“Don’t know how to use it. That’s the reason...There is no need to use such a high level [equipment]...Google Doc can also fulfil similar purposes.” (G1)

“I never use electronic ones. I use just white... you just need some time and stuff. But when you want to write something quick...convenience, quick access I would say.” (G6)

“[I will usually] take a photo [of the contents on whiteboard] with mobile phone, WhatsApp and then go.” (G2)

In the current study, manual whiteboards appeared to be an item frequently mentioned by the interviewed groups as evidenced in Table 1. For instance, the planning details and

arguments of groups G3 and G10 were systematically captured on whiteboards during a discussion in the observations. Many positive comments were also collected from interviewees about the general and specific values of whiteboards such as the ones below:

“The whiteboard can help to list out the points of discussion systematically. And also some examples can be clearly shown under each point.” (G10)

“Sometimes it’s easier to write than to type something. Because sometimes you need to draw some figures and this is more difficult to be done on a computer. But it will be easy to draw with a pen. So it will be better to have a whiteboard if your work involves some figures or new concepts.” (G2)

As articulated by many groups during the interviews, the discussion room was associated with the application of many social and cognitive skills for CPS suggested in the developmental progressions of ATC21S mentioned above. Among all the social skills, “interaction” under “participation” was the only one selected by all groups interviewed (n=10). When asked to identify the contributing factors for this skill in the discussion room, the whiteboard was deemed to be one of the key factors:

“I think display is most important. Because when you want to discuss something in a group, you don’t want like you just look around and show it. So actually I would set display.” (G6)

“But because we have more members and not everyone can have a computer to input all the things quickly. So if one can write down the things on a whiteboard, everybody can receive the message very efficiently.” (G10)

“When we are in the same space without much distraction, we can express clearly our thoughts and respond to others. Even if there’s anything unclear, it can be immediately clarified instead of expressing it by email or WhatsApp.” (G11)

Another element among the social skills quoted by many groups (n=6) was “negotiation” under “social regulation”. Whiteboard was again indicated as a helpful facility in the room:

“We will be more ready psychologically. Probably for negotiation, the time restriction will drive people to work out a solution faster.” (G9)

“Maybe negotiation especially for some sound proof rooms. We may face some debates or quarrels among our discussion. But it can help us to come to an agreement maybe more quickly. Cause we can discuss or even debate freely if the room is sound proof.” (G8)

“It is inevitable to have different opinions. But you have to say and explain things clearly, and apart from just talking, you might need to draw and write things out, so that things will be easier to understand for everybody. For example, a whiteboard will be helpful. Other groupmates can see [the things written there] and add their own opinions, or further help us to think of the problem clearer, so that’s helpful.” (G11)

In terms of cognitive skills, half of the groups interviewed (n=5) agreed that a discussion room helped them to regulate tasks as well as to build learning and knowledge through the following elements:

#### *Task regulation - Organizes (problem analysis)*

“For this, I think the whiteboard helps a lot. You can draw mind maps or your organization [of thoughts]. At the beginning, we can brainstorm or draw mind maps. And then we can plot our research organization and so forth. It makes everything clearer.” (G5)

“When organizing...or we’d write down some points [on the whiteboard]...Sometimes we’d get lost when we navigate through documents. So we’d jot down some points and look at it. It’s better that way.” (G11)

#### *Task regulation - Collects elements of information*

“First of all, I will use the whiteboard to breakdown the elements of information by writing it down and showing it to everybody. Then if I need to gather information, I will go to Google... Usually, we will distribute the works by separating the elements and then assign tasks to different members.” (G5)

“...because with the whiteboard you can use mind maps and list everything out clearly. It also relates to ‘identifies connections and patterns between and among elements of knowledge’.” (G12).

#### *Learning and knowledge building - Relationships (Represents and formulates)*

“We will use the projecting system and TV or whiteboard, etc. to display it [relationship].” (G5)

“I think it helps in the aspect of relationships...It’s especially helpful when we have to draw mind maps here [whiteboard].” (G9)

“Regarding whiteboards, I feel that it’s to clarify concepts, then you would draw connections between them on the whiteboard, so it may be useful to solve any legal issues on the whiteboard.” (G12)

#### **Discussion and conclusion**

The findings clearly showed that the value of a whiteboard was recognized by many interviewees in tackling problems



by groups through the application of cognitive skills. It proved that an effective visual display facility could help students “analyze and describe a problem in familiar language”, “explore and understand elements of the task”, and “identify connections and patterns between and among elements of knowledge” (Hesse et al., 2015).

Almost all the groups agreed that the quiet and exclusive environment of discussion rooms with some useful facilities such as the visual display system and whiteboard altogether enhanced the interaction between members as they could communicate in an undisturbed, direct and effective manner. From an environmental and behavioral point of view, the subjects also found their CPS benefited from the discussion room facilities to a certain extent. A similar finding was reported in the research of Quinnell (2015) about students’ tendency to complete difficult assignments and subjects in spaces where affordances were obvious and they had control over the environment.

Despite the negative perceptions associated with unmet expectations in some cases such as poor acoustics and inappropriate furniture setting, the subject groups generally found the group discussion/study rooms on campus a more helpful resource as compared to an open meeting place in other informal learning spaces on campus. The results unfolded that the major contributing factors of these dedicated discussion rooms were their tranquil and controlled environment, formal layout for meetings, and some practical facilities that met user needs such as the whiteboards and visual display system.

Among all the environmental factors and room facilities that afford the users to apply the cognitive skills in CPS, it was surprising to find that seven of the eleven comments referred to whiteboards as the agent that supported those skill-related tasks. The significance of this simple tool in group work and CPS was actually far beyond its financial value. On the other hand, application of the aforesaid developmental progressions in analyzing the value of discussion room facilities in developing and utilizing social skills and cognitive skills for CPS can also be viewed as an inspirational approach in understanding these common facilities. The findings will hopefully help facility planners develop successful projects by taking into account both the theoretical and practical perspectives.

Group	Major purposes of visit and/or activities carried out	Facilities and mobile devices used	Averaged duration per visit
G1 (SocSc & Archi)	Group projects, class assignments	Laptops, smartphone, WiFi, projection system	2 – 6 hours
G2 (Med)	Class assignments	Laptops, WiFi, projection system	1 – 2 hours
G3 (Misc)	Extracurricular activities	Whiteboard, computer, WiFi	N/A
G4 (Arts)	Class presentations	Laptops, WiFi, power sockets	N/A
G5 (Archi)	Class assignments, group projects, preparation for competition or interviews	Video recorder, whiteboard, laptop, WiFi, projection system, power sockets	Depending on needs
G6 (Sc, Bus&Econ)	Class and examination revision, group projects, class assignments, extracurricular activities	Laptops, WiFi, power sockets, projection system, whiteboard	2 – 10 hours depending on needs
G7 (Sc)	Class assignments	Laptops, smartphone, WiFi	N/A
G8 (Engg)	Group projects, class presentations, extracurricular activities, private study	Laptops, iPad, smartphone, WiFi, projection system, whiteboard, e-whiteboard, power sockets	1 – 2 hours
G9 (Sc & SocSc)	Group projects, class assignments, extracurricular activities, hangout with peers	Laptops, smartphone, WiFi, whiteboard, projection system, power sockets	1 – 2 hours
G10 (Law)	Class assignments, extracurricular activities	Laptops, WiFi, whiteboard, power sockets	2 hours
G11 (Edu)	Group projects, class presentations	Laptop, iPad, WiFi, projection system, whiteboard, power sockets	4 hours or more
G12 (Law)	Group project, group revision	Laptops, WiFi, whiteboard, e-whiteboard, projection system, power sockets	1 – 2 hours
G13 (Med)	Class presentations, discussion of class materials	Laptops, WiFi	1 – 2 hours

**Table 1. Summary of findings for group observations and interviews**

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# How do students learn in a low-tech gamified flipped classroom instruction? The role of autonomy, competence, and relatedness

**Zamzami Zainuddin**

The University of Hong Kong  
Hong Kong  
zamzamizain@hku.hk

**Samuel K.W. Chu**

The University of Hong Kong  
Hong Kong  
samchu@hku.hk

**Hussein Haruna**

The University of Hong Kong  
Hong Kong  
harunahussein@gmail.com

**Rudi Kurniawan**

Sekolah Tinggi Ilmu  
Administrasi Nasional,  
Indonesia  
krudi7621@gmail.com

**Zanzibar Zanzibar**

Institut Agama Islam Negeri  
(IAIN) Lhokseumawe,  
Indonesia  
zanzibar.aceh@gmail.com

**Mulia Andirfa**

Sekolah Tinggi Ilmu Ekonomi  
(STIE) Lhokseumawe,  
Indonesia  
andirfa@stie-  
lhokseumawe.ac.id

## ABSTRACT

This study aimed at examining students' learning performance and perceived motivation between flipped-classroom and gamified flipped classroom instruction in a low-tech information setting. The iSpring Learn LMS was employed as a low-tech tool in gamifying the flipped classroom. The study employed a quantitative research approach, using three formative assessments or a post-test only design to examine students' learning performance. A questionnaire was employed to support the data collection process in terms of students' perceived motivation based on a Self-Determination Theory (SDT) approach. Fifty-six students were the respondents involved in a non-randomized experiment with a control group design. The results reveal that assessment 1 showed no significant difference between the two groups of the gamified flipped and non-gamified flipped classroom instruction ( $p > .05$ ), while assessments 2 and 3 were significantly different ( $p < .05$ ). The survey results reveal that the gamified flip-class setting fostered better motivation and engagement. Particularly, students motivated to compete and beat other students during the gamification activities by collecting points and badges as many as possible. This study suggests that the flipped classroom and gamification concept might be possibly implemented in a low-tech information environment without the required advanced technology platform.

## Keywords

Gamification, flipped classroom, self-determination theory, motivation, achievement, low-tech information settings

## Introduction

The term 'gamified flipped classroom' is derived from the combination of the gamification concept and flipped

classroom instruction. Gamification is the use of game elements in non-game activities. Groening and Binnewies (2019) define gamification as the use of game-based elements or game mechanics, such as points, badges, or leaderboards to enhance people's interest and motivation through competition. The game elements or mechanics can be applied in various forms, including achievement badges, avatars, boss fights, collections, content unlocking, gifting, leaderboards, level progressions, point systems, quests, social graphs, teams groups, and virtual goods (Buckley & Doyle, 2017). Furthermore, the flipped classroom is defined as an instructional strategy and a part of blended learning instruction, where the students understand and comprehend the instructional contents before attending class by watching video-recorded lectures (Zainuddin et al., 2019). The gamified flipped classroom in this study means that some game-based elements (e.g., scores, points, badges, and leaderboards) were incorporated into the flipped classroom practice through an online gamification quiz. Thus, students in this study not only watched the pre-class video lectures outside of the class, but also they were required to complete a gamification LMS quiz with questions related to these videos and compete to earn scores, points, and badges. The quiz and game-elements were distributed through a low-tech platform called iSpring Learn LMS (<https://www.ispringsolutions.com/ispring-learn>). This activity is expected to motivate students to watch and understand the pre-class materials before attending class.

## Self-determination theory

Students' learning motivation in this study is discussed based on a self-determination theory approach. In this theory, motivation is distinguished into extrinsic and intrinsic motivation and both of them play a crucial role in promoting students' engagement and learning performance (Abeysekera

& Dawson, 2014). The SDT is a motivational theory that offers provisions that improve a student's sense of autonomy, competence, and relatedness, which is supported by the internal factor of motivation or the so-called intrinsic motivation (Ryan, Rigby, & Przybylski, 2006). Therefore, in this study, students who have three main intrinsic needs in their study are considered as intrinsically motivated students. Based on the above discussion, this study aimed at examining students' learning performance and students' perceived motivation, which focuses on three intrinsic needs of competence, autonomy, and relatedness, between gamified flipped classroom instruction and a non-gamified classroom instructional model.

Autonomy is defined as the ability to complete a responsibility independently with limited supervision from the instructor while competence can be perceived as the ability to master content efficiently and compete with others competently. Then, relatedness is viewed as students' ability to interact and collaborate with peers and their instructor during teaching and learning activities (Abeysekera & Dawson, 2015). Students' activities in this study including gamified, inquiry and experiential-based learning activities are expected to magnify students' high sense of autonomy, competence, and relatedness. Therefore, to sum up, the three criteria, competence, relatedness and autonomy are the building blocks of SDT associated with flipped classroom learning and gamification. With regard to this study, SDT has been widely discussed in gamification (e.g., Aldemir, Celik, & Kaplan, 2018; Baydas & Cicek, 2019; Jurgelaitis, Čeponienė, Čeponis, & Drungilas, 2019; Lopez & Tucker, 2019) and flipped classroom studies (e.g., Marchalot et al., 2017; Sergis et al., 2018; Thai, De Wever, & Valcke, 2017; Zainuddin, Haruna, Li, Zhang, & Chu, 2019) as a guide to enhance students' learning motivation and engagement, as well as academic performance. In gamification studies, for instance, several game elements have been employed to maintain the three intrinsic needs in students' learning activities, such as points, performance graphs, badges, and leaderboards, which can all be employed to support the competence domain through feedbacks. Avatars can then be used to support the need for autonomy through decision freedom and meaningful stories through volitional engagement. Besides, teammates and meaningful stories can also be applied to meet the need for social relatedness through students' collaboration (Sailer, Hense, Mayr, & Mandl, 2017).

Given the aim of this study, two research objectives were formulated to operationalize the targeted goals of this study: (1) to examine students' learning achievement between the gamified flipped classroom and non-gamified flipped classroom through the intervention process; and (2) to identify students' perceived needs for competence, autonomy, and relatedness between the two groups of intervention.

## **Methodology**

This study employed a quantitative research design where the data were collected through post-tests quasi-experimental design (formative assessments) and questionnaire surveys. This methodology made a conceptual sense to investigate the gamified flipped model of instruction implemented in the science course for a secondary school in Indonesia. The participants of this study comprised 56 students selected from two different science classes, 27 students from the gamified flipped class and 29 from just flipped class. Their ages span between 15 and 16 years of age. All 56 students completed the survey questionnaires.

### **Procedure of data collection**

Both gamified flipped (GFC) and flipped classrooms (FC) were taught once a week (100 minutes) with the same content and instructor. The gamified flipped class was considered as an experimental group, while the non-gamified flipped class was a control group. Students of the gamified flipped class learned by watching educational video lectures from home and later reconvened in the classroom to participate in face-to-face classroom activities, group discussions, and student presentations. Besides, outside of the class, the students in the gamified flipped classroom were also required to answer several quiz questions on the LMS gamification system, related to the pre-class materials. Through this online gamification system, the students were able to compete to earn as many points and badges as possible.

In this study, several YouTube video lectures were also uploaded on the LMS for students' learning outside of the class. After watching videos, the students attempted to answer the e-quiz question on this LMS, earn points and badges and track their achievement progress on the leaderboard. So, the more the students accessed and passed the quizzes, the more they received the points and the more they won many badges. Furthermore, for the instruction given to non-gamified flipped class instruction was quite similar to that of the gamified-flipped classroom, but without the online gamification quiz outside of the class time. The students in this control group were only required to watch the video lectures before class, take a note, and come to class prepared with a paper-based quiz and discussion activity.

### **Data collection and analysis**

This research was carried out over 12 weeks in the first academic semester (2017/2018). The intervention activities were administered from week 1-11, including eight topics with three post-tests (formative assessments), to examine the students' learning performance. 20 questions provided to each assessment with a score of 5 for each correct answer and the highest score was 100. The last week (week 12) was used to distribute the questionnaire survey to all students in this study. As this analysis attempts to identify and compare students' learning performance and perceived motivation

between the two groups (gamified flipped classroom and flipped classroom), the independent sample t-test was operationalized with a significant level of 0.05 (2-tailed).

## Results

### Formative assessments

Three assessments were repeatedly conducted over three months during the intervention to assess and compare students' learning performance between the gamified flipped classroom (experimental group) and flipped classroom (control group). Table 1 reveals the t-test scores of the two groups, showing the differences in students' learning achievement for both classroom models. For the first assessment, the independent sample t-test reported that there were no significant differences between the two groups ( $t = .76, p > .05$ ). However, the second assessment reported significant differences between the scores of the two groups ( $t = 2.97, p < .05$ ). This implied that students' academic performance in the gamified flipped class, for the second assessment, was better than that of the flipped class.

As for the third assessment, it was reported that there were also significant differences found between the scores of the two groups ( $t = 4.92, p < .05$ ). These results implied that students' academic performance in the gamified flipped class for the third assessment was much better than that of the control group. Significant differences in the mean scores of assessments 2 and 3 were found among the two groups, but not in that of assessment 1. This might be partly due to the fact that, at the beginning of the intervention, none of the students in the two groups were familiar with new instruction and initial assessment. On the other hand, the two subsequent assessments were reported significant differences due to an iterative instructional cycle or formative assessments received by the students.

Assessments	Groups	n	M	SD	t	p
I	GFC	27	71.67	7.60	.76	.45
	FC	29	69.66	11.60		
II	GFC	27	77.03	5.60	2.97	.005*
	FC	29	70	11.10		
III	GFC	27	88.15	9.42	4.92	.000*
	FC	29	75.34	10		

**Table 1. Descriptive statistics and independent samples t-test results to compare students' academic achievement in the gamified flip-class and non-gamified flipped-class**

\* $p < .05$

### Survey questionnaires

A 15-item survey questionnaire was employed to identify students' perceived levels of competence, autonomy, and relatedness between the two groups. Five items were employed to identify each intrinsic need. The t-test was then used to compare the two groups.

### Perceived competence

Table 2 depicts that the mean scores of the gamified flipped

class in item 1 were  $M = 4.08, SD = .062$ , but the flipped classroom was  $M = 3.87, SD = .581$ . The results implied that there was no significant difference ( $p > .05$ ) between the groups regarding students' perceived competence in terms of class performance. The mean score results of Item 2 implied that students from the gamified flipped classroom ( $M = 4.22, SD = .698$ ) were perceived to be more able to manage their learning as compared to the flipped classroom ( $M = 3.76, SD = .872$ ). The t-test results further indicate a significant difference between the two groups ( $p < .05$ ). The results of item 3 implied that most students in the gamified flipped class were perceived to be more capable of using technology as compared to another class ( $p < .05$ ).

Items	Groups	n	M	SD	t	p
1	GFC	27	4.08	.062	1.33	.190
	FC	29	3.87	.581		
2	GFC	27	4.22	.698	2.19	.033*
	FC	29	3.76	.872		
3	GFC	27	4.37	.741	2.48	.016*
	FC	29	3.86	.790		
4	GFC	27	4.30	.724	2.43	.018*
	FC	29	3.80	.819		
5	GFC	27	4.30	.724	2.14	.037*
	FC	29	3.87	.790		

**Table 2. Descriptive statistics and independent samples t-test results for comparing students' learning competence in the gamified flipped classroom and non-gamified flipped-class (5-point Likert, strongly disagree – strongly agree)**

\* $p < .05$

For Item 4, the results implied that students of the gamified flipped class were more competent in asking critical questions as compared to another class ( $p < .05$ ). Based on this finding, it can be assumed that watching video lessons out of class allowed students to grasp a gist of the lesson before attending class and prepared for critical questions. Furthermore, in line with the previous item, the mean scores of the fifth item implied that students of the gamified flipped class ( $M = 4.30, SD = .724$ ) were more critical thinking skills than that of the flipped classroom ( $M = 3.87, SD = .790$ ). The t-test also indicated a significant difference between the two groups ( $p < .05$ ).

### Perceived autonomy

Table 3 summarizes the differences in students' perceived autonomy based on SDT. The Table depicts that students from both groups show positive responses to learning autonomy. However, the mean score results of all Items (6-10) reports were significantly different. For instance, the results of Item 7 implied that most students in the gamified flipped ( $M = 4.56, SD = .578$ ) were perceived to be able to control their learning environment by working when it was convenient for them. The t-test result also shows a significant difference with another group ( $p < .05$ ). This suggests that students in the gamified flipped classroom were perceived to be able to study outside of the classroom, at their own pace,

time, and place. For Item 9, the result shows that the students in the gamified classroom were perceived to be more able to control their learning speed when outside of the classroom ( $p < .05$ ). This Item implied that students in the gamified flipped classroom were perceived to be more able to stop, pause, fast-forward, or rewind the lectures at any time, or re-watch as many times as needed. Finally, Item 10 implied that students of the gamified flipped class believed that they had improved an intrinsic motivation in terms of better management and control of learning time.

Items	Groups	N	M	SD	t	p
6	GFC	27	4.52	.580	.086	.024*
	FC	29	4.18	.540		
7	GFC	27	4.56	.578	.083	.004*
	FC	29	4.10	.557		
8	GFC	27	4.52	.580	.029	.012*
	FC	29	4.14	.516		
9	GFC	27	4.63	.565	.113	.001*
	FC	29	4.14	.516		
10	GFC	27	4.60	.572	.064	.003*
	FC	29	4.18	.516		

**Table 3. Descriptive statistics and independent samples *t*-test results for comparing students' learning autonomy in the gamified flipped classroom and non-gamified flipped-class (5-point Likert, strongly disagree – strongly agree)**

\* $p < .05$

### Perceived relatedness

Unlike the previous analysis (competence and autonomy), Table 4 depicts that only Item 11 shows a significant difference between the gamified-flipped class and the flipped classroom with  $t = 3.84$ ,  $p < .05$ . This Item implied that the students in the experimental group were able to interact with peers both in the class and outside of the class. Whereas students in the control group can be implied that they have difficulty interacting with peers after the class hours due to a limited technological platform used for online interaction. Furthermore, although the gamified flip-class shows a higher Mean score for Items 12 to 15, there were no significant different responses between the two groups. All items were asked about students' in-class experiences such as classroom discussion, working in a group, and stimulate critical thinking skills. It can be viewed as a very small difference between two means for each item. For instance Item 13 shows that Mean score of the first group was  $M = 4.11$ ,  $SD = .751$  while the second group was  $M = 3.86$ ,  $SD = .441$ .

Items	Groups	N	M	SD	t	p
11	GFC	27	4.19	.622	3.84	.000*

	FC	29	3.48	.738		
12	GFC	27	4.19	.622	1.46	.149
	FC	29	4	.267		
13	GFC	27	4.11	.751	1.53	.133
	FC	29	3.86	.441		
14	GFC	27	4.19	.622	1.75	.086
	FC	29	3.93	.458		
15	GFC	27	4.26	.447	1.64	.106
	FC	29	4.03	.566		

**Table 4. Descriptive statistics and independent samples *t*-test results for comparing students' relatedness in the gamified flipped classroom and non-gamified flipped-class (5-point Likert, strongly disagree – strongly agree)**

\* $p < .05$

### Concluding discussion

This study was conducted to compare the impact of students' learning performance between the gamified flipped-class and flipped classrooms with a low-tech gamification platform. In terms of students' learning performance, the result of students' assessments shows that students' scores in the gamified flip-class environment were higher than that of students in the non-gamified flipped class, particularly in the second and third assessment. Accordingly, the questionnaire survey also reveals that students' in the gamified flipped-class were much better in their competency than that of the non-gamified flipped class. The fact shows that the mean scores of most items of students' competence beliefs are higher than that of the non-gamified flipped class. Students in the gamified flipped-class showed more competence in learning and mastering new skills either in the classroom or outside of the class.

The result of this study can be implied that students felt more competent as they had more opportunities to take ownership of their learning, as they could prepare and learn pre-class lessons at home before attending the class, as well as competing toward the gamified quiz activities. These out-of-class activities enabled students to understand the subject better because of having prepared before attending class. The findings are coherent with that of Sams and Bergmann (2013), whereby students of flipped classes revealed that they felt more confident and competent engaging in classroom activities because they were prepared before coming to class. According to Deci and Ryan (2002), individuals were more intrinsically motivated when they engaged and interacted in group activities.

Besides students' competence, the gamified flipped-class approach also supported students' learning need for autonomy. This instruction had successfully integrated a flexible learning environment, established student-centered learning, developed autonomous learners, and critical thinkers. They also were able to study outside of the classroom at their own pace; more enjoyable and pleasurable to do the work at their own time and place. Students were also able to control their learning speed during watching pre-

class video lectures; play, stop, pause, fast-forward, or rewind the lectures at any time, or re-watch as many times as needed. This finding is coherent with Awidi and Paynter (2019) who found that innovative instructional practices used in the teaching reinforced students' autonomous learning and improved their motivation. Various studies have sought to determine the benefits that the flipped classroom and gamification model have on learners' autonomy. Green and Schlairet (2017) found that the flipped learning approach introduced in classrooms improved the learners' academic performance, learning attitudes and participation levels.

In terms of learning autonomy, interactive activities in the flip-class setting allowed learners to practice and make better progress with their communication skills, and this, in turn, can have a positive impact on their motivation. In terms of relatedness, students believed that they learned something new through their gamified flipped classroom experience. It was a simple free technological platform (iSpring Learn LMS) for them to exchange information online with peers and their instructor, and develop themselves in the areas of critical thinking. This finding is coherent with the previous studies that the flipped-class instruction model successfully enhanced and promoted peer interaction in students' learning (e.g., Goedhart, Blignaut-van Westrhenen, Moser, & Zweckhorst, 2019; Tsai et al., 2019; Wang, 2017).

Meanwhile, incorporating gamified activity into the flipped classroom shows that students' social engagement was not only related to students-peer interaction through an online platform or during classroom discussion but also engaged in gamified activities. This means that gamified instruction enables students to also interact with peers through a competition. Students might be able to compete with other students like playing a game in order to achieve high points and get badges. This finding is coherent with Baydas and Cicek (2019) that team leaderboards enhanced learner-learner interaction through a competition. Various studies have sought to determine the benefits that the flipped classroom model has on learners' autonomy. Therefore, this study summarized that the implementation of the gamified flip class model has successfully achieved students' three intrinsic needs, namely, competence, autonomy, and relatedness.

We believe that the implementation of conventional flipped classroom instruction needs to be redesigned with a novel extension and the so-called gamified flipped classroom. The gamified-flipped classroom approach, which merges gamification with the flipped classroom pedagogies, may prove to be an innovation that improves students' twenty-first-century learning skills. We believe that by merging a gamification concept into the flipped classroom practice can be a novelty and contemporary model of flipped classroom instruction. In this proposed model, students will develop and deepen their understanding about the pre-class contents

(e.g., videos and books) by answering gamified quiz questions and compete with each other to get game elements such as badges, avatars, boss fights, collections, content unlocking, gifting, leaderboards, level progressions, point systems, quests, social graphs, teams groups, and virtual goods. This study also suggests that the flipped classroom and gamification concept might be effective in promoting the 21st-century learning skills in a low-tech information setting, and the implementation is not bounded by advanced technological platforms/ designs.

Gamification as a current concept of a twenty-first-century instructional skill has proved to be remarkably influential. The employment of game-like features can be a powerful means to produce more engaging and fun activities in the classrooms. This study has confirmed that integrating the gamification concept into flipped classroom instruction by adding challenges, incentives, points, and rewards to quiz questions promoted a more engaging and enjoyable experience for learners. Meanwhile, although the findings of the study cannot be generalized to the whole secondary students' population in Indonesia, this may be partially due to the diverse nature of different settings, the key findings offer indispensable insights into successful school change and promote positive learning outcomes among school learners.

It is, however, recommended that future studies employ samples from other academic courses and also from other schools and universities. Further works are also profoundly recommended to study such an issue through a qualitative study so that a more in-depth understanding of the benefits of the gamified concept can be reported. We believe that the summary of this paper may provide valuable insights for researchers, practitioners, and educators in issues related to flipped classroom and gamification research, and it may be used by researchers as a reference for potential future research in the field of education. Finally, we end by suggesting points of departure for continued empirical investigations of gamified practices and their effects.

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# STEPS: Developing argumentative writing skills of secondary school students with Wiki collaborative writing and information literacy

**Helen Sau Ching Cheung**  
HKSKH Ming Hua Theological  
College, Hong Kong  
helen@minghua.org.hk

**Samuel K.W. Chu**  
The University of Hong Kong  
Hong Kong  
samchu@hku.hk

**Elizabeth Ka Yee Loh**  
The University of Hong Kong  
Hong Kong

## ABSTRACT

Writing and information literacy are both important skills for students worldwide. Existing literature in Western countries shows that information technology, information literacy, and a constructivist approach, such as Wiki collaborative writing, can benefit students, but there is limited research related to secondary school students in Asian areas with other non-Western languages such as Chinese. This paper will discuss the effect of the “STEPS” model. STEPS means developing students’ writing competence during the steps of their writing process. STEPS is used for easy reference throughout this project as the interventions are placed on the various steps of writing. This exploratory study investigates how adoption of STEPS (i.e. the use of collaborative teaching by an academic librarian of higher education and language subject teachers of schools, and the use of collaborative learning through PBworks (Wiki), a free and easy-to-use writing platform) can create a collaborative learning environment, to develop the argumentative writing competence and information literacy skills of F4 students (Grade10) in Hong Kong. The STEPS model utilizes design-based research. This study is a one-year project involving a total of 126 students and 7 subject teachers from a boys’ secondary school in Hong Kong. The results show that STEPS helped these students to enhance their writing competence, revision strategies, and information literacy skills, as well as their ability to explore different points while writing. A comparison between pre-test and post-test results shows that the students’ levels of information literacy, revision strategy, and attitude towards writing (thinking that writing is important) significantly increased ( $p < 0.05$ ) after the adoption of STEPS. Also, feedback and grading from teachers on students’ writing indicates that the students’ writing was enriched in terms of claims, evidence, and content.

## Keywords

Inquiry-based learning, information literacy, Wiki collaborative writing, collaborative teaching

## Introduction and research gap

As with most other countries, writing is an important life-long skill for Hong Kong students, both in their learning in school and after graduation in their work. Students are required to write assignments and reports, and to take examinations. Both Chinese and English are official languages in Hong Kong, with Chinese being the first language written and spoken among most Hong Kongers. However, Hong Kong secondary school students’ writing competence, writing process (e.g. planning and editing skills), attitude towards the writing process (e.g. thinking that writing is important or interesting), and interest in writing are all weak. This issue is reflected in both their writing work and public examination results. Recently, nearly half of the students have not achieved the local minimum university entrance requirements for the Chinese language. Their writing in the subject of the Chinese language is particularly weak compared to the other three language skills (listening, reading, and speaking). Students also find writing difficult or are not interested in it. Students’ particular areas of weaknesses include content, structure, grammar, and typographical errors (HKEAA, 2015 & 2016).

Hong Kong students’ common Chinese writing problems are:

- Writing topics are not well defined or do not meet topic requirements
- Content is weak or not relevant to the topic
- Claims are weak or not relevant to the topic
- Evidence is insufficient or weak in supporting claims
- Incorrect warrants are used (a warrant is a method of connecting the evidence to the claim)
- Integrated writing skills (e.g. summarizing and synthesizing skills) are insufficient (HKEAA, 2013)
- Own ideas are not elaborated
- Paragraphs or sentences lack structure and are incoherent
- Grammatical mistakes and punctuation

and typographical errors are recurrent

- Writing is regarded as difficult or not interesting

In recent years, the Hong Kong government has encouraged schools to use information technology in education, as well as to use collaborative learning to develop students' subject knowledge (e.g. Chinese language and information literacy). Although students' Chinese writing skills are weak, this is a scarcely researched area in Hong Kong. Specifically, there is a lack of studies to help secondary school students in Hong Kong to develop their Chinese writing competence through information technology, information literacy, and collaborative learning.

**The aim of this research**

There are many writing genres. Argumentative writing is not

only compulsory for primary and secondary school students to learn but is also necessary for exams. Argumentative writing skills are also important for writing research reports and theses at university. Therefore, this research focuses on argumentative writing. This study (table 1) sets out to investigate how the adoption of the STEPS model, involving collaborative learning, Wiki collaborative writing and information literacy, during the student writing process can help mitigate students' weaknesses in Chinese argumentative writing competence, especially in defining topics, content (claim, evidence, warrant), integrated writing skills, structure, grammar, pronunciation, and typographical errors, and also how STEPS may enhance their awareness of the writing process.

Information literacy	Writing competence	Writing process	Writing attitudes
<ul style="list-style-type: none"> <li>• Develop a topic</li> <li>• Identify potential sources</li> <li>• Develop, use, and revise search strategies</li> <li>• Understand what plagiarism is</li> </ul>	<ul style="list-style-type: none"> <li>• Claim</li> <li>• Evidence</li> <li>• Warrant</li> <li>• Structure</li> <li>• Integrated writing skills (summarizing, parenthesizing, synthesizing, elaborating)</li> <li>• Expression</li> <li>• No typographical errors</li> </ul>	<ul style="list-style-type: none"> <li>• Understand and incorporate the writing process</li> </ul>	<ul style="list-style-type: none"> <li>• Positively change students' writing attitude</li> </ul>

**Table 1. Constructs related to the aims of the research**

**Literature review**

***From “product-oriented” method to “process-oriented” method***

Teachers tend to be product-oriented while being less concerned about students' writing processes in the pedagogy of Chinese language teaching (Li, 2014). Moreover, the learning process is highly driven by the teachers, who provide students with the models of writing, establishing such requirements as the topic, form, and length (i.e. word limit) of writing assignments (Pasand & Haghi, 2013; Li, 2014). The teachers at the same time serve both as the main readers and the assessors of their students' writing. This has resulted in the phenomenon that students write in solitude and write specifically for their teachers (Parson, 1985). In addition, conventional teaching methods rely largely on teachers' comments. Teachers correct mistakes for the students when they mark the essays instead of guiding them in editing their essays themselves (Xu, 2009). Consequently, students' ability in actively revising their writing is lessened (Liu, 2012). Teachers' methods should be seen as the roots

of solutions for improving students' writing abilities and mitigating weaknesses in the traditional pedagogy. Western societies have a well-established constructivist teaching approach for improving students' English writing, involving process-oriented, guided inquiry learning, collaborative writing, Wiki use, composition scale, etc.

Constructivism is defined as “the belief that the learner is active in shaping how new knowledge is taken in and shaped and, furthermore, that new understandings emerge progressively as learners develop hypotheses, test those hypotheses and re-shape their understandings on the basis of experiences” (Ng & Nguyen, 2006, p. 41). To bolster the writing competence of students, a number of previous studies have used process-oriented methods (e.g. Flower & Hayes, 1981; Hayes & Flower, 1983; Cioffi & Carney, 1997; Baroudy, 2008). The process-oriented method is generally defined as providing guidance during the writing process, emphasizing teachers' provision of meaningful assistance in students' writing processes in terms of prewriting, drafting, and revising and editing (Cioffi & Carney, 1997; Flower & Hayes, 1997; Chen, 1997). It has also been shown that

successful and unsuccessful authors demonstrate differences in their writing processes, where the former delicately arrange their writing and the latter seldom design the structure of their writing or revise their drafts. An apparent contrast in these authors' writing processes has been shown in terms of their prewriting, drafting and editing, and so on (Atwell, 1981; Barlett, 1981; Flower & Hayes, 1981; Chang, 1993). Thus, this "process-oriented" method of teaching writing has recently been taking over from the traditional product-oriented method.

### ***Wiki collaborative writing and Wiki (PBworks)***

Collaborative writing is the better-known learning mode suggested in constructivist teaching and denotes two or more authors participating in the writing process together, mainly aiming to shorten creation time, alleviate the workload, and improve writing quality through collaboration (Noel & Robert, 2004, as cited in Chung, 2010). Wiki is one of the commonly used online collaborative writing platforms.

Wiki collaborative writing for English writing has been widely researched (e.g. Scardamalia, 2002; Storch, 2011; Woo, 2013). For Chinese writing, research has been conducted on matters related to process-oriented writing (e.g. Chang, 1992; Kuo & Chen, 1995; Tse, 1984; Yeung, 2011), Wiki collaborative writing (e.g. Yang & Weng, 2008; Shu & Chuang, 2012), and Wiki collaborative writing with inquiry-based learning (Li, 2014; Li, Chu, & Ki, 2014). Most of these studies indicate that process-oriented Wiki collaborative writing and inquiry-based learning have positive effects on students' writing processes and their exploration of ideas from peers. Providing feedback to students about their writing is also shown to be important. Studies show that a composition scale can help students to self and peer evaluate as well as assist teachers in providing feedback (e.g. Shum, 2005; Tse, 2003).

PBworks is a web-based Wiki platform that is suitable for a low-tech environment. For example, the education version of PBworks is free of charge. Also, teachers do not need to write code or program. All they need to do is create accounts for students with simple steps, then teachers and students can have their own PBworks workspace for their project. Also, PBworks can be used on both desktops and hand-held devices with Internet access. Several previous studies such as those of Woo (2013) and Li (2014) have used PBworks for collaborative writing, generating positive results that students can easily share ideas and keep track of the writing record of each student.

### ***Inquiry-based learning, collaborative teaching, and information literacy***

Previous studies of inquiry-based learning and collaborative teaching with librarians and subject teachers have shown benefits to both students and teachers. In particular, students' information literacy ability appears to influence their

inquiry-based learning. For example, Chu (2012) and van Aalst, Hing, May, and Yan (2007) found that secondary school students in Hong Kong experienced confusion and uncertainty during the initial stage of inquiry-based learning. Van Aalst et al. (2007) also reported that although students perceived the internet as the most important source of information, they were unable to find a starting point when faced with the abundance of information online.

Abstraction is one of the core abilities of information literacy, as exemplified by Pinto, Doucet, and Fernández-Ramos (2008) (as cited in Chu, 2012). It is important to cultivate students' abstracting abilities, including reading and comprehension, analysis, interpretation, synthesis, organization, and writing competence. Chiu-Lee (2002) also pointed out that secondary schools in Hong Kong were blindly promoting inquiry-based learning, but both students and teachers lacked knowledge about this learning mode. This led to students' over-emphasis on cutting-and-pasting, copying, and piling-up information. Overall understanding of the topic and analysis of information were absent. The common problem among students was spending too much time searching for, piling up, and even directly copying others' information. They merely gathered relevant information into a "good report", devoting too little time to understanding, analyzing, and integrating different kinds of information. These activities would ultimately lead to serious issues, namely a lack of new discoveries, new learning, overall originality, and a sense of possession. Consequently, students could not effectively develop high-order thinking through inquiry-based learning. In contrast, they could be overloaded by the amount of work, missing the gist of inquiry-based learning.

Apart from the teachers themselves, their co-operation with school librarians also benefits students in inquiry-based learning, as students receive more support in their learning (e.g. Chu, 2009; Chu et al., 2012; Harada & Yoshina, 2004; Kuhlthau, 2010; Kuhlthau & Maniotes, 2010; Kuhlthau, Maniotes, & Caspari, 2007). Also, students can develop their writing and information literacy skills through inquiry-based learning (Chu et al., 2012). For example, students' scores have increased 38%-39% in their inquiry project-based learning (Chu, 2009).

### **Research questions**

In view of these research gaps, this study sets out to address the following research questions:

- i. How does STEPS affect students' writing competence, process, and attitude?
- ii. How does information literacy affect students' writing competence?
- iii. How do Wiki collaborative and collaborative learning affect students' writing competence?

## **Methodology**

### ***Participants***

Four classes of Secondary 4 students ( $N = 126$ ), seven Chinese subject teachers, one teaching assistant from a secondary school in Hong Kong participated in this study. The participating secondary school is a band one school. In Hong Kong, secondary schools are divided into three bands according to their academic performance (e.g. students' scores in public examinations) with the first band being academically strongest.

### ***Theoretical framework***

In this project, Chinese subject teachers and librarians engaged in collaborative teaching to enhance students' argumentative writing, summarizing, parenthesizing, synthesizing, and information literacy. Students were divided into groups of five and required to do wiki collaborative writing for argumentative essays.

The framework for this research is adopted from the model of the writing process used by Flower and Hayes (1981) and Hayes (1983). As shown in Figure 1, the writing process includes preparation, drafting, editing, and finalizing the work. Typically, the assessment of Chinese writing focuses on content, grammar, structure, punctuation, and typographical precision. The main interventions of this research lie in the following areas:

- i. Scaffolding in argumentative writing.
- ii. Exercises in summarizing, parenthesizing, and synthesizing skills.
- iii. Scaffolding in information literacy, including defining topics, searching for information and evaluating it for claims, and evidence of the students' writing, as well as the knowledge and use of information ethics (e.g. understanding what plagiarism is).
- iv. Wiki collaborative writing: use of PBworks as the online writing platform.

### **Research design**

There are three phases of this research.

The first phase (pre-test): To find and identify students' levels of writing competence, perceptions of their writing process and attitude, and levels of information literacy. Each student is required to write an individual piece of argumentative writing with paper and pencil and to complete a questionnaire about their writing process and attitude as well as an information literacy quiz.

The second phase (intervention by collaborative teaching): Argumentative writing is taught by Chinese subject teachers, whereas information literacy, how to use PBworks, summarizing, paragraphing, and synthesizing are taught by the librarian.

The third phase (intervention by collaborative learning): Students of each class are divided into groups, (usually 4 or 5 students per group) to produce argumentative writing using collaborative writing and PBworks.

The fourth phase (post-test): each student is required to write an individual piece of argumentative writing with paper and pencil and to complete a questionnaire about their writing process and attitude as well as an information literacy quiz.

### ***Data collection***

This study uses a mixed-method approach to collect both quantitative and qualitative data. There are multiple sources of quantitative and qualitative data both before and after the intervention. Quantitative data were collected from various questionnaire responses, assessment scores of both individual and collaborative writings, and scores of information literacy quizzes. Qualitative data were collected from semi-structured group interviews and students' writings.

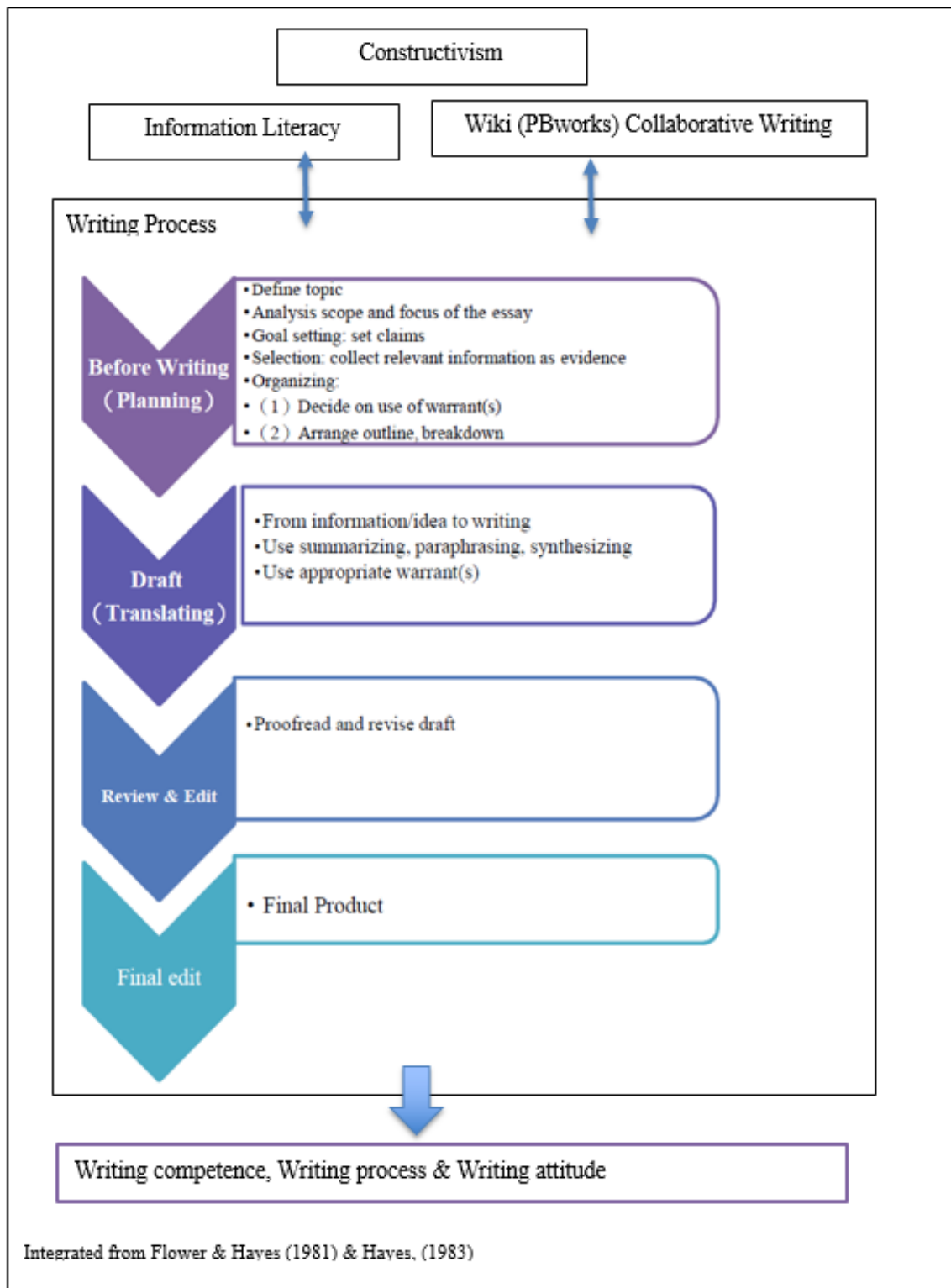
All surveys used the five-point Likert Scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The quiz on information literacy (Chu, 2012; Yeung, Chu, & Chu, 2012) was conducted before and after the intervention. Half of the total groups from each class were selected randomly to be focus groups for face-to-face, semi-structured interviews.

### ***Data analysis***

The quantitative data from the quizzes, questionnaires, and writing scores were analyzed by paired samples *t*-test. This was used to compare the pre-intervention and post-intervention results of individual students regarding their information literacy, writing competence as reflected in their individual writing, perceptions towards the writing process, and writing attitudes. SPSS was used for statistical analyses and  $p < 0.05$  was considered as statistically significant.

This paper focuses on the discussion of results from the quantitative data supplemented by feedback from semi-structured interviews with focus groups of students and individual teachers. In the future, qualitative data from the interview transcripts were analyzed in detail using NVivo 11 with sequential analysis and Axial coding

Figure 1: Research Framework



## Findings and discussion

### *How does STEPS affect students' writing competence, process, and attitude?*

The performance of students' individual argumentative essays in the pre- and post-intervention.

The total scores for the two argumentative essays show significant positive changes ( $p < 0.05$ ) after the interventions (Post > Pre). Besides that, scores of various writing areas including content, grammar, structure, and no typographical errors show significantly positive improvements ( $p < 0.05$ ) in the post-intervention argumentative essays.

#### Writing process

Students show significant positive changes ( $p < 0.05$ ) in understanding of the writing process post-intervention (Post > Pre). The perception questionnaires answered by students show that: students agreed that STEPS helped them to understand more about the writing process (mean 3.2); they will use the writing strategy they learned in this project for their future writing (mean 3.4); writing strategy should be included in their writing lessons (mean 3.5); the learning skills in this project helped them to learn in other subjects (mean 3.3) and helped their reading skills (mean 3.2).

#### Writing attitudes

Students show significant changes ( $p < 0.05$ ) in attaching value to writing (i.e. believing writing skills are important). On the other hand, students do not exhibit significant changes in writing enthusiasm, but teachers reported that more students submitted their writing homework on time, whereas in the past a number of students would submit later or even not submit writing homework.

### *How does information literacy affect students' writing competence?*

To compare the students' pre- and post-intervention scores on the information literacy quizzes, a paired samples t-test was used. The results show that students significantly improved ( $p < 0.05$ ). Most students and all participating teachers offered positive comments about the training on information literacy, which included helping students to find relevant and reliable information, to learn more searching strategies and skills, to speed up their writing, and to make writing easier. Students expressed that they were aware of and could use more sources for their writing after the training, and therefore the content of their writing was enhanced. Before the intervention, students might only have used their own opinions in argumentative writing, but after the intervention they would use relevant and more authoritative sources in their writing. Also, students were more aware of the idea of plagiarism (e.g. student A "I didn't know quoting my previous work without referencing it is plagiarism"). Students were more aware of how to avoid it, which is potentially relevant to other subjects (e.g. Liberal

Studies, etc.), as they also need to make use of information sources for these subjects.

Affected by summarizing, paragraphing, and synthesizing training

Eighty percent of the participating teachers thought the summarizing exercise could help students in selecting main ideas. For example, Teacher A expressed that "I think the summarizing training benefits both students and teachers. Students can learn to select main ideas from a passage and as a teacher this is also a way to train them". Therefore, they would consider adding this kind of exercise in the Chinese writing sessions of the Chinese lessons in Secondary 1 and 2 classes. Furthermore, all participating teachers gave positive feedback that STEPS as an integrated pedagogy helped students in improving various skills they need in Chinese writing: synthesizing (3.2), claims (3.4), evidence (3.4), and warrant (3).

### *How do Wiki collaborative and collaborative learning affect students' writing competence?*

Seventy-five percent of the students perceived that they benefited in a variety of ways from group members in their writing by using Wiki collaborative writing and collaborative learning. For example, they were more competent in defining topics of a piece of writing and ensuring their content matched with the topic. Eighty percent of the students also pointed out that some reference sources and ideas that came from group members could be better than their own. In addition, the writing composition scale was shown to be helpful for students in getting a clearer idea about how to evaluate both their group work and individual work. Seventy-three percent of the students deemed that using the composition scale for peer evaluation with their classmates could help them enhance writing competence. Moreover, 78% of the students felt eager to have the chance to evaluate other group members' work using the composition scale, as this evaluation was "like a game" (group 4c4 and group 4d2) to these students.

Collaborative writing was also found to be beneficial to students in terms of improving their grammar, coherence, and structure, but 88% of students still needed to rely on help from their teachers (3.22). For example, group 3d1 explained that "comments from teachers were important as these comments were more constructive and less technical than those from their peers". These findings were consistent with those from Wiki, as the system shows that students' peer reviews mainly covered correction of typographical and punctuation errors, instead of higher-level issues such as the structure of the writing.

#### PBworks

Students pointed out that PBworks is easy to use and provides them with opportunities to engage in collaborative learning and collaborative writing. For example, PBworks

allowed them to access various learning materials and to learn from their peers (i.e. group members and classmates), which was better than traditional one-way learning from teachers only. Wiki helped them diversify their knowledge and provided an extra platform and space for them to practice writing and to collaborate with classmates beyond the limits of the classroom, and also allowed them to archive their work for their reference in the future. Also, Wiki allowed students to learn from their peers so that some claims from others enhanced their ideas. Nevertheless, most students pinpointed that the speed of their Chinese input (i.e. typing speed) could be an obstacle when using Wiki, as slow typing could lead to inefficiency in completing writing tasks.

Students therefore need more training and practice in inputting Chinese words on computers, as Chinese characters are very different from the English alphabet, especially in the context of computer input. During this study, teachers found that several students did not know how to type in Chinese or were working at a slow pace when inputting because of the nature of work being done in the Chinese language. Some students used Google Translate (typing English for the Chinese translations as direct “output”) and some needed to use their smart phones to access the mobile version of the Wiki as they felt it was more convenient for inputting Chinese words (the students could use their fingers to write Chinese characters on their mobile screens). This issue regarding the speed of Chinese input also influenced students’ attitudes and their perception of the helpfulness of Wiki. All participating teachers agreed that Wiki helped students through collaborative writing and learning as well as recording and showing the students’ learning process. Besides, teachers pointed out that PBworks’ high usability and lack of cost can aid the continuing of the writing project due to no extra funds being required and the fact that students (especially those who do not have computers at home) can use their mobile phones for writing on it.

### Conclusion

This study indicates the positive impact of STEPS model on students’ writing competence, their perceptions towards the writing process, and their attitudes about writing. Also, as a result of the intervention programs used in this research, students and teachers were more aware that students’ Chinese inputting speed had to be increased; it was found that students who finished their writing promptly on Wiki were those who type fast. Another unanticipated yet interesting finding was that students’ attitudes towards the use of Wiki were somewhat dependent on their typing speed, especially in Chinese as this study involved Chinese writing. It would therefore be worthwhile to investigate whether these issues would present themselves in other contexts such as English writing.

Students and teachers both praised the training on information literacy in the intervention programs of this study. Knowledge and skills in information literacy could help students improve their writing competence, especially in core areas including content, claims, and evidence in their writing (i.e. argumentative writing). Students demonstrated enhanced awareness of and ability in searching for authoritative information sources and evaluating these sources. Also, students were more aware of the idea of plagiarism. Ethical use of information is a prominent issue nowadays, particularly when students will be facing more and more information in their prospective years of learning. Chinese subject teachers may not possess expertise in information technology, but this study enabled teachers themselves to learn more about new information technologies, such as Wiki. Also, not being highly familiar with information literacy before participating in this study, teachers were now satisfied with their new knowledge of useful pedagogical tools including the plagiarism checker as well as advanced search tools such as “AND”, “OR NOT”, and “site:edu”. This study’s findings could be useful for modifying the STEPS model and adapting it to the teaching and learning of Chinese writing in other Hong Kong secondary schools. Also, PBworks, an online collaborative writing platform available either for free or at a low cost and usable by people with low tech skill, can facilitate collaborative learning.

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# Which measurements are most relevant to peer review?

**Lele Kang**

Nanjing University, China  
lelekangnju@gmail.com

**Chao Min**

Nanjing University, China  
mc@nju.edu.cn

**Qingqing Zhou**

Nanjing University of Science  
and Technology, China  
breeze7zhou@163.com

**Shum Yi Cameron Lee**

The University of Hong Kong  
Hong Kong  
sycamlee@hku.hk

**Bei Luo**

Nanjing University, China  
151070046@smail.nju.edu.cn

**Jiang Li**

Nanjing University, China  
lijiang@nju.edu.cn

## ABSTRACT

In this paper, we analyzed the correlation between peer review and Altmetric scores, citation counts and Publons ratings, based on 2,547 scientific publications in Publons. Each article was scored between -1 and 1 by sentiment analysis of the post review (after publication peer review) in Publons which were created by registered peers of the authors. Then, correlation analysis revealed that the sentiment score of the post review of the articles was significantly negatively correlated to their Altmetric scores, whereas no significant correlation was identified between peer review and other measurement.

## Keywords

Peer review, Altmetrics, Citations, Publons, Sentiment analysis, Correlation analysis

## Introduction

The crisis of peer review for journal articles in academia has been concerned in recent years by at least two reasons. One is the dramatical increase of submitted manuscripts especially from developing countries/territories. The other is the short of recognition of reviewers' contribution from academia due to anonymous review. Most reviewers would not publish their comments publicly although a few journals advance a transparent peer review scheme, e.g., Nature Communications (Nature, 2017). Therefore, even if it is suggested that academia should recognize reviewers' contribution, it still can hardly ease the crisis of peer review within a short period.

Undoubtedly, unstructured interview is most relevant to the true measurements of scientific advances, compared to other qualitative or quantitative indicators (Narin, 1978). However, peer review for journal articles is sometimes criticized, because gatekeepers of sciences, i.e., reviewers and editors of journals, who legitimize scientific findings sometimes, reject unconventional or outstanding work (Siler, et al., 2015). Hence, self-archiving preprint of

scientific articles is popular, and it is believed that science benefits from openness (Nature, 2017). In this research, we aim at addressing the question "which indicators are most relevant to peer judgments?"

## Literature review

Peer review and quantitative indicators are two major methods for scientific evaluation. It is agreed that the two methods measure different aspects of science. Experiment results from Du, Tang & Wu (2016) suggested that expert recommendation score from F1000 only had a weak correlation with the number of citation counts of a research paper, ranging from 0.2 to 0.3. They also found that less innovative papers received more citations and lower expert recommendation scores, while more innovative papers received higher expert recommendation scores yet less citations. Bornmann & Leydesdorff (2015) analyzed the relationship between quality and citations of research articles, and revealed the discrepancy between the quantitative indicators and the qualitative judgements by peers. On eleven social media platforms such as Twitter, Facebook, Google+, etc., Thelwall et al. (2013) systematically investigated the performance of articles published in PubMed and found that the Altmetric scores of these articles in social media did not show a significant correlation with their citations from academic articles. The fact that Altmetric score has only a weak correlation with citation counts is further verified by subsequent studies, such as Costas, Zahedi & Wouters (2015). The difference between expert review and quantitative indicators implies that the outputs of scientific research should be separated based on the nature of the research when they are subjected to evaluation.

Sentiment analysis is the computational study of people's opinions, sentiments, emotions and attitudes (Liu, 2015). The techniques of sentiment analysis can be classified into two categories: lexicon-based approaches and supervised learning approaches (Saif, He & Fernandez et al., 2016). The

former calculates the sentiment tendency value of a text by summarizing the sentiment value of each component in the text. Since sentiment polarity determination can be viewed as a classification task, many machine learning techniques such as Naïve Bayes, Decision Tree, Support Vector Machines, K-Nearest Neighbor etc. are applied in sentiment analysis. But such algorithms often require large amount of tagged data.

The latter is thus more applicable under the condition of lack of sufficient tagged data (Han et al., 2018). Review texts are useful in many scenarios such as consumer analysis, social media analysis, fake news, etc., thus are often subjects to sentiment analysis. For example, Pang, Lee & Vaithyanathan (2002) find that machine learning techniques outperform human judgement in determining the sentiment of movie reviews. Salehan & Kim (2016)'s study on online consumer reviews shows that reviews with positive sentiment in the title gain more readerships and that longer reviews are more helpful to consumers. In recent years, the detection of Twitter posts sentiment has also been often applied both in commercial sector to improve product sales and in public sector to investigate public sentiment (Saif, He & Fernandez et al., 2016).

### Data and methodology

Publons is a website for academics to track, verify and showcase their peer review and editorial contributions for academic journals (<https://publons.com>). It contains 1,235,787 papers, 6,257 of which received 7,188 post reviews, and most of them (81.13%) receive only one post review. We collected the post reviews as the peer review data source in this study. The following five journals receive relatively more reviews than others, including MedEdPublish (93), Asian Journal of Pharmaceutical and Clinical Research (84), Construction and Building Materials (75), Plos One (75), and Nature (46).

In this study, scientific papers are evaluated with four measurements, i.e., Altmetric scores, Publons ratings, citation counts, and sentiment scores of posted reviews. The four measurements actually represent how a scientific publication is rated from different dimensions. First, Altmetric scores, given by public, show general readers' evaluation of the paper on both social media and traditional media platforms. Second, Publons ratings, provided by Publons system, could be interpreted as how Publons users evaluate the quality of the paper. It is measured by taking the average value of papers' quality score and papers' significance score on Publons system. Third, citation counts show how the academic fellows evaluate the study. High citations indicate the paper gets recognized in academia. Fourth, the last variable, sentiment scores of the posted reviews, is measured by taking average value of sentiment score of each paper's posted reviews.

The sentiment analysis is conducted by extracting sentiment

indicators (i.e. positive and negative words) based on a predefined sentiment lexicon (i.e. SentiWordNet, <http://sentiwordnet.isti.cnr.it/>), and then calculating the sentiment score of each posted review based on the following equation (Pang and Lee 2008). This variable indicates the reviewers' evaluation of the study,

$$\text{Sentiment score of review}_i = \frac{\#pos_i - \#neg_i}{\#pos_i + \#neg_i} \quad (1)$$

Where, Sentiment score of review<sub>i</sub> is sentiment score of the i-th review; #pos<sub>i</sub> and #neg<sub>i</sub> is number of positive words and negative words in review<sub>i</sub>.

### Preliminary results

After data cleaning, 2,547 papers are used in the descriptive statistics and correlation analysis. Figure 1 shows the distribution of the four measurements, i.e., Altmetric scores, Publons ratings, citation counts and sentiment scores. Note that Almetric scores and citation numbers were taken log transformation in the diagrams. Long tail is identified in the distribution of Altmetric scores and citation counts, which indicates the Altmetric scores and citation counts of most of the sampled articles are low. Normal distribution is found in the distribution of Publons ratings and sentiment scores. It is worth noting that some post reviewers made extremely positive comments on the papers and the sentiment score of the papers is as high as 1 in Figure 1.

For a randomly sampled dataset of submitted manuscripts, the sentiment score of pre review comments is supposed to be normally distributed between -1 and 1. Then, in general, positively reviewed manuscripts were published by journals. The sentiment score of post review comments for published papers is mainly positive, as shown in Figure 1. It indicates two different possibilities. One is that post review is consistent with pre review in terms of sentiment, i.e., significant studies were evaluated positively in both pre review and post review. The other is that different from anonymous pre review, named post review forced reviewers to put on only positive comments on Publons.

Table 1 reports descriptive statistics and the correlation among the four measurements. It is clear that Almetric scores is significantly correlated with citation counts ( $r=0.10, p < 0.001$ ) and publons ratings ( $r=0.05, p < 0.05$ ). These three measurements seem to consistently evaluate the quality of the publications. A surprising finding here is that sentiment score of post review for publications has a significant and negative relationship with Altmetric score ( $r = -0.05, p < 0.05$ ). It reveals that public opinions to the value of the paper may be opposed to peers' evaluation on Publons.

### Summary

We conclude that peer review (referring to post review rather than pre review) is significantly negatively correlated to Altmetric scores of the publications, based on 2,547

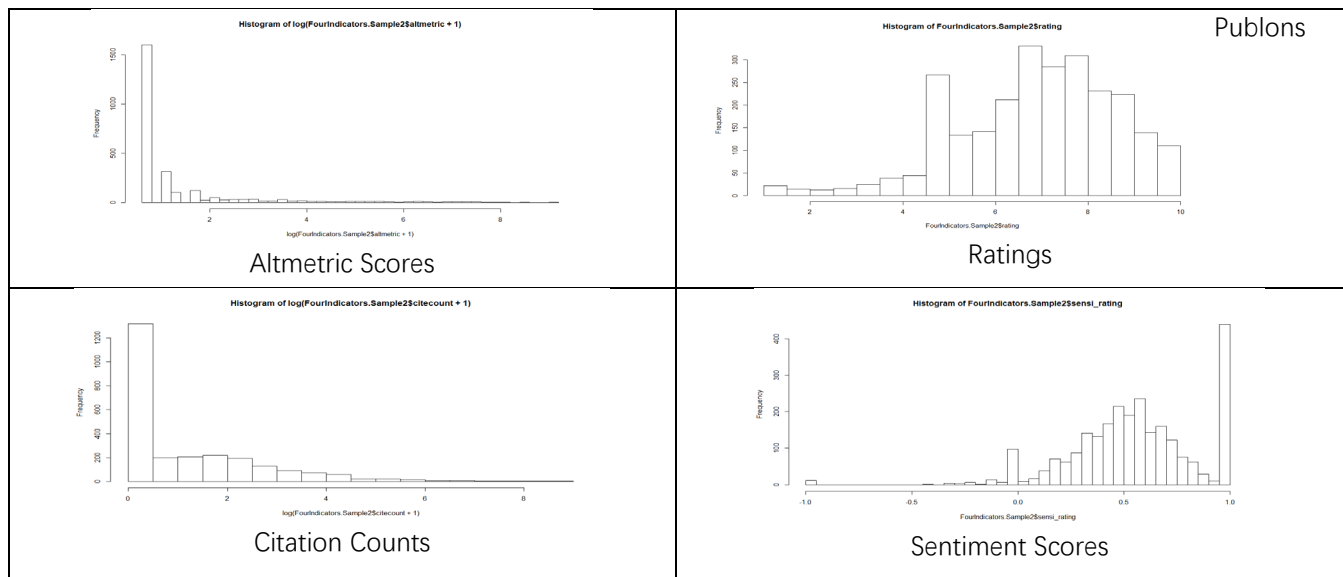
publications in Publons and sentiment and correlation analysis of the dataset. The short of pre review comments in Publons leads to the adoption of post review comments, when we quantified the measurement of peer review. It is worth noting that compared to anonymous pre review system, named post review system may force reviewers to judge positively. Next, we will collect pre review comments from Nature Communications or other transparent peer review journals, and identify corresponding post review comments from Publons, in order to measure the difference

between them. Then, we will correlate pre review with Altmetric scores, citation counts and Publons ratings.

Variable	Mean	SD	[1]	[2]	[3]	[4]
[1]Altmetric Scores	38.73	283.04	1.00			
[2]Publons Ratings	7.07	1.73	0.05*	1.00		
[3]Citation counts	21.00	212.41	0.10***	0.05*	1.00	
[4]Sentiment Scores	0.56	0.30	-0.05*	-0.03	-0.02	1.00

**Table 1. Descriptive statistics and correlation coefficients**

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$



**Figure 1. Distribution of the four measurements**

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# An Approach to Teaching Academic Writing Focusing on Argument Structure and Information Organization

**Wei-Ning Cheng**  
Wee Kim Wee School of  
Communication and  
Information, Nanyang  
Technological University,  
Singapore  
wcheng009@e.ntu.edu.sg

**Christopher S.G. Khoo**  
Wee Kim Wee School of  
Communication and  
Information, Nanyang  
Technological University,  
Singapore  
assgkhoo@ntu.edu.sg

## ABSTRACT

Academic writing, and more specifically research paper writing, is a skilled task involving complex mental processes integrating thinking and writing skills. We propose an approach to teaching research paper writing that focuses on three types of thinking skills: argumentation, information organization, and research thinking. We describe an ongoing project to analyze research articles published in high-quality journals—to identify the different types of argument structure and information structure, and how these differ in different types of research, thus reflecting different types of research thinking. Analysis of argument structure involves first identifying the types of argument claims and supporting arguments found in research articles, and then common micro-sequences of argument claims (argument step patterns) as well as common argument support => argument claim pairs. Information structure analysis seeks to identify common information patterns using the idea of semantic frames—which represent the main types of information and relationships that are linked to a core concept. We propose that these argument patterns and information patterns can be taught to students to strengthen the thinking skills needed in research paper writing.

## Keywords

Ontology, Teaching Academic Writing, Ontology for Argumentation, Argumentation

## Introduction

Academic writing encompasses all the essays and reports writing that students do to satisfy course and program requirements at the university. It includes the writing of term papers, reflective essays, research reports, and theses. Academic writing is a skilled task that requires several types of skills applied in an integrated way to produce an effective piece of text that is easily understandable, coherent and conveys new knowledge to the reader.

Academic writing requires more than a good command of the language. Many academic writing teachers have realized that good academic writing requires good thinking skills of the appropriate types (e.g., Leong, 2015; Phakiti & Li, 2011). Wingate (2012) pointed out that a critical component to developing an argument is presenting the author's position in a logical text structure. Mallia (2017) also indicated that “before writing tasks”, an author needs to think of a strategy (i.e. how to organize information in the text structure) based on the objective of the paragraph and paper as a whole.

In this paper, we propose an approach to teaching research paper writing that focuses on three types of thinking skills: argumentation, information organization, and research thinking. We have embarked on a project to analyze research articles published in high-quality journals, to identify the different types of argument structure, types of information structure, and how these differ in different types of research, thus reflecting different types of research thinking.

Argumentation skill is needed to construct good arguments to support the purposes of the research paper (e.g., to convince the reader that the results of the reported study are valid and a significant contribution). Many kinds of arguments are made in a research paper but they have to work together (i.e. integrated into a coherent argument structure) to convince the reader. The arguments also have to be presented sequentially in the text (i.e. in a textual argument chain or flow) to guide the reader to grasp the whole argument structure. Researchers in academic writing and genre studies are increasing studying argumentation in academic papers (e.g., Andrews, 2007; Konstantinidou & Macagno, 2013).

Information organization skill involves selecting and including specific kinds of information in different sections of the research paper, and linking the pieces of information into an overall structure. It also involves incorporating

selected pieces of information in different types of arguments and incrementally presenting pieces of information as part of the argument flow.

This skill of thinking and writing is not only a challenging task for teachers to teach, but a difficult skill for students and scholars to learn, especially for younger scholars who are non-native English speakers. This paper reports an ongoing study to analyze the argument structure and information structure in research journal articles, currently focusing on the field of sociology, with a planned extension to mechanical engineering and bioscience. This will yield insights on the kinds of argumentation and information organization skills that are needed in research paper writing, as well as providing examples of the application of these skills in the text of the research articles published in high-quality journals. The results of the study can be used to support evidence-based teaching of academic writing.

The approach taken in analyzing the argument structure of research papers is to first identify the types of argument claims and supporting arguments, and then the common micro-sequences of argument claims (argument flow patterns) as well as common types of supporting arguments associated with each type of argument claim (argument claim-support patterns). Similarly, information structure analysis seeks to identify common information patterns using the idea of semantic frames—which represent the main types of information and relationships that are linked to a core concept (e.g., an event or situation). We propose that these argument patterns and information patterns can be taught to students to strengthen the two types of thinking skills.

We have identified five types of sociology research: Investigative research, Development and evaluation research, Historical analysis, Descriptive research, and Identification research. The most common types of research in our sample of sociology research articles are Investigative research and Descriptive research. Journal articles reporting different kinds of research evince different strategies for selecting and structuring arguments and information. We propose that it is important for students to be familiar with different kinds of research thinking associated with different types of research.

Some previous studies have investigated argument structure and information structure in research papers. However, these studies are more limited in scope and were carried out with different end goals. Wingate (2012) proposed a framework for teaching argument development in student essays based on three thinking skills: analyzing and evaluating relevant research information from the literature, establishing a position (i.e. an argument claim), and presenting the position logically in the text. Stab and Gurenych (2017) proposed a computational method to parse the argument structure in student essays, using discourse analysis to model the

argument structure as a connected tree structure. These perspectives of argumentation are similar to ours, but we adopt a bottom-up evidence-based approach in analyzing journal papers to derive more detailed argument patterns that can be taught to students. Our study also seeks to develop in more detail the information structures in research papers that have been used in previous studies (e.g., Ou, Khoo, & Goh, 2007).

### Argument structure analysis

An argument in an academic paper is an assertion that the author seeks to convince the reader of, using supporting evidence or logical reasoning. It can be divided into the argument claim (e.g., that a research objective is well-founded and worth investigating) and supporting argument (e.g., a research gap). We have identified 27 types of argument claims as well as 11 types of supporting arguments in the Introduction of sociology research papers. An argument claim can also function as support for a subsequent argument claim. We refer to the network of argument claims and supporting arguments as the argument structure.

An argument structure can be an abstract structure presumed to exist in the author's mind, but can be represented explicitly in a graphical or network diagram, with directed edges from supporting arguments to claims (e.g., a mind map or ontology). However, the argument claims and supporting arguments have to be presented in the text in a serial order. We refer to the sequential chain of argument claims presented in a text as the textual argument chain or flow, and the underlying abstract structure as the logical argument structure. We assume that the logical structure is the deep or abstract structure that is mapped to or generates the textual or surface structure.

Here is the basic (or common) textual argument chain found in the Introduction of sociology research papers:

Topic centrality/General statement ->  
Research gap/Research issue/Research question -> Research objective/Research hypothesis -> Research contribution/recommendation.

We found that some arguments (e.g., the definition of concepts/terms) can be inserted anywhere in the basic argument chain.

We identified frequently occurring micro-sequences of textual argument claims (argument flow patterns) that can be taught to students. Common patterns that involve the Research objective include:

Research gap -> Research objective, and  
Research objective -> Research contribution/recommendation.

We also identified frequently occurring *argument support* => *argument claim* logical patterns.

The more common ones are:

- Research hypothesis => Research objective
- Research question => Research objective
- Research hypothesis => Research question
- Research result => Research contribution/recommendation
- Research contribution/recommendation => Research objective

An argument claim may be supported by two or more supporting arguments, for example:

*Cited authors' claim & Theoretical mechanism* => Research issue (i.e. justifying a research issue by highlighting a previous author's claim, bolstered with a plausible theoretical explanation).

A common logical argument pattern is Research gap => Research question => Research objective (i.e. justifying a research objective by raising a research question that is based on a research gap in extant literature). In the text, this argument pattern is presented in the same sequence: Research gap -> Research question -> Research objective.

### Information structure analysis

Argument claims and supports have semantic content, comprising several pieces of information (i.e. concepts) linked together. For example, a research objective may state that a *concept A* influences another *concept B*, together with related information. These may be represented as a network of concept -> relation -> concept triples, which we refer to as an *information structure*.

We identified a few common information structure patterns in the Introduction of sociology papers, that we represent as semantic frames. Two important semantic frames found in sociology research papers are:

- *Research-relation frame*, representing a research relation (e.g., *Cause-effect*) between two concepts, as well as related information such as the modality (e.g., true, negation and possible), context information (e.g., location), and size or magnitude (e.g., small). See Figure 1.
- *Comparison frame*, representing a comparative relation between two or more concepts and the comparison result.

We analyzed the relative frequencies of the different types of information in each semantic frame, as well as how the different semantic frames are linked together in research

papers.

In our preliminary analysis of 14 sociology Introductions reporting Investigative research, all of them involve one or more *Cause-effect relations*. A majority include *Association relations* (10 of 14) and *Comparison relations* (8 of 14). *Context* information (especially *location* or *environment*) and *Evidence* (especially *research method*, *data source* and *time* of data collection) are common types of information in the Introduction. Only three of 14 Introductions indicate a *difference* between two compared concepts; the rest just indicate that the concepts are compared, without additional information.

We have also developed other semantic frames as information structures commonly associated with other types of research: *Development and evaluation frame* (associated with Development and evaluation research), *Descriptive frame* (associated with Descriptive research), *Theory/model/framework frame* (found in all types of research) and *Measurement frame* (not often found in Sociology Introduction sections, but expected to be found in Method and Research results in sections of papers).

In a research paper, multiple types of information structures are instantiated and linked together. In the Introduction of sociology papers reporting Investigative research, the *Research-relation frame* is often linked with a *Comparison frame*, and sometimes with a *Theory/model/framework frame*. For example, a paper may propose a new model to explain a particular phenomenon (i.e. *Cause-effect* relation) by comparing the results for two categories of subjects.

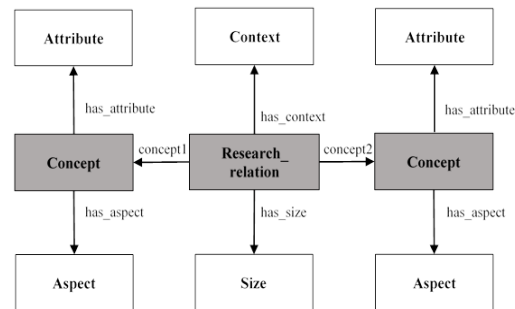


Figure 1. Research-relation frame

### Types of information in different argument steps

To understand how information is used to support arguments in a research paper, we analyzed what types of information are specified in different argument claims and support. We focus on the following frequent *support => claim* patterns (referred to as *logical argument steps*) which encapsulate information necessary to understand the research objectives, results, and contributions, the core arguments in a research paper:



- Topic centrality => Research gap
- General statement => Research objective
- Research gap => Research objective/Research question/Research hypothesis
- Research objective/Research question/Research hypothesis => Research result
- Research result => Research contribution/recommendation

In our analysis, the most common pattern is the Research gap => Research objective/Research question/Research hypothesis argument step (9 of 14). We found that a research relation may be stated more generally in the Research gap argument (e.g., *Association* relation) and more specifically in the Research objective argument (e.g., *Cause-effect* relation). Most of the Introductions specify additional information in the Research objective, including effect size (e.g., high), context (e.g., the *location* or *environment* of the research), or an aspect of the cause/effect concept.

### Types of research

There are clear differences in information structure in papers reporting different kinds of research. Our discussion above has focused on Investigative research, the most common type of research in sociology. We have identified the following five types of sociology research:

1. *Investigative research*, which seeks to investigate a research relation (e.g., causal and associative relation) between concepts, usually using quantitative research methods. The information structure can often be represented by the *Research-relation frame*, *Comparison frame*, and *Theory/model/framework frame*.
2. *Development and evaluation research*, which seeks to develop or evaluate a complex concept (e.g., theory, model, framework, measurement or system). The information structure is focused on the *Development and evaluation frame* and *Comparison frame* (to compare competing theories/models/frameworks).
3. *Descriptive research*, which seeks to explicate a phenomenon or an event, usually using qualitative research methods. The information structure is focused on the *Descriptive frame* and *Comparison frame*.
4. *Historical analysis*, which seeks to explicate a change in a particular phenomenon (including the development of an entity) over a period of time, often based on historical data analysis. The information structure is focused on the *Descriptive frame*, *Comparison frame*, and *Theory/model/framework frame*.

5. *Identification research*, which seeks to identify a subtype or instance of a concept. This type of research is not common in sociology.

Analysis of the argument structure for the different types of research is in progress. We expect to find differences in the relative proportions of different argument patterns in different types of research.

### Application to teaching academic writing

This paper has described an approach to evidence-based teaching of academic writing, focusing on argument and information structure. Students should be taught the types of information that are expected to be specified for different types of research, with examples from actual journal articles. They should also be taught the basic argument chain in research papers as well as common micro-argument patterns. Besides, they should be taught how the different types of information are used in different arguments.

In addition to the Introduction section of sociology research papers, we have analyzed Abstracts and will extend the analysis to the Literature Review section. We shall also extend the study to journal articles in mechanical engineering and bioscience.

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# A Systematic Survey on District Health Information System (DHIS): A Bibliometric Analysis

**Fei Yu**

University of North Carolina at  
Chapel Hill, USA  
feifei@unc.edu

**Nandita Mani**

University of North Carolina at  
Chapel Hill, USA  
nanditam@unc.edu

**Manish Kumar**

University of North Carolina at  
Chapel Hill, USA  
manishk@email.unc.edu

**Javed Mostafa**

University of North Carolina at  
Chapel Hill, USA  
jm@unc.edu

## ABSTRACT

As open-source software, the District Health Information System (DHIS) and its enhanced version – DHIS 2 have emerged as a de facto web-based global platform for health data collection, analysis and use in more than 50 countries. Many of these countries are in low-resource and low-tech environments. Particularly, African and Asian governments have been using DHIS to strengthen their health information monitoring and measuring capacity. However, research evidence on the relationship between the health outcomes and DHIS/DHIS 2 adoption and usage is fragmented and hard to generalize even though such a knowledge base is the key to nurturing innovative use of technology for improving data-based decision-making. This study attempts to fill the gap by applying bibliometric data analysis to a systematic survey of scientific literature on DHIS/DHIS 2. This first attempt will help governments, international organizations, and donors to be aware of the research status, prioritize digital health studies, promote inter-institutional collaboration, and facilitate the strengthening processes to achieve better health outcomes.

## Keywords

District Health Information System (DHIS), bibliometric analysis, low- and middle-income countries (LMICs)

## Introduction

The adoption of innovative digital health interventions such as mobile health and web-based information systems can greatly enhance the availability of and accessibility to quality data for monitoring progress and impact of both population and patient-centered health programs in low- and middle-income countries (LMICs) (Pryor, Gardner, Clayton, & Warner, 1983). As an open-source software platform, the District Health Information System (DHIS) and its enhanced version -DHIS 2 have drawn global interests and are being used by governments and development organizations in over

50 countries to collect and analyze data for public health decision-making and disease surveillance (Gardner, Golubjatnikov, Laub, Ja-cobson, & Evans, 1990).

Current research on DHIS 2 focuses on strengths and operational challenges associated with its use in LMICs to provide information to policy-makers for decision making (Dehnavieh et al., 2018). However, the research evidence on the relationship between the health outcomes and DHIS/DHIS 2 adoption and usage is fragmented and hard to generalize even though such a knowledge base is the key to nurturing innovative use of technology and improving data-based decision making (Thomas et al., 2016). To fill this gap, we started by conducting a systematic survey on the scientific literature about DHIS and DHIS 2. This attempt expected to understand the research output and landscape of DHIS/DHIS 2 studies including research output, publishing channels (i.e., journals or conference proceedings), key researchers and their collaboration networks, countries and organizations involved in the studies, and important research topics or health outcomes. We concluded by describing our findings, identifying gaps, and highlighting future research directions.

## Method

The literature search was conducted in six citation databases – PubMed, Scopus, Web of Science (WoS), EBSCO, IEEE Xplore, and ACM Digital Library. Other sources for the literature included the references of searched records and recommendations from an expert associated with DHIS/DHIS 2 at the University of Oslo where DHIS and DHIS 2 have been developed and maintained. We developed search strategies (Table 1) to identify literature that contains the term or term variations of “district health information system,” such as “dhis,” “district health information system2,” or “dhis2” in the title, abstract, and keyword fields. We did not include the terms like “health information system” or “health management information systems,” or

“health information systems program (HISP)” which are too broad and would have brought up many false positive search results. Although DHIS/DHIS 2 is one of the main activities of HISP (PATH, 2016), the purpose of the literature search was to retrieve all articles which studied DHIS or DHIS 2 specifically instead of examining other activities associated with HISP.

The search was first conducted in March 2017 and then was updated in February 2018. Upon removing duplicates, the search produced 81 records for bibliometric analysis. Two coders (FY, MK) independently screened each record the search produced during the title and abstract review phase. Results were limited to studies that were produced as English language, abstracts were available, and which focused on DHIS or DHIS 2 as a digital health software platform for health information management and data use (Figure 1). Since this study was conducted to prepare for a systematic review on digital innovations in global health with a focus on DHIS/DHIS 2, a full-text article review and screening process is planned as the next step based on the insights from this study.

In this study, we took a bibliometric analysis approach to provide an overview of the DHIS/DHIS 2 studies in terms of the annual distribution of publications, source types, co-authorship networks, and research topic network. Tableau was used to generate the quantitative analysis and visualization of the year and source distribution of included publications. Co-authorship networks and the research topic networks were produced by importing the bibliographic records of the included publications to VOSviewer (Version 1.6.8) (Eck & Waltman, 2018), a bibliometric network analysis software. Each unique country, organization, author, or key term was extracted as a node, and the top nodes were visualized to demonstrate the patterns and trends.

Density maps and network time-overlay maps were created to show the pattern change over time.

## **Results & discussion**

### ***Research Output and Source Title***

All 81 included articles that were published from 1995 to 2018 (Figure 2). Particularly, the research publications experienced a sudden increase since 2011 and reached a peak in 2017. Besides, the included articles appeared in a total of 54 journals/conference proceedings and two books. The proceedings of the IST-Africa Conference and the South Africa Medical Journal published more articles included in this study than the other journals or proceedings (Figure 3). A majority of the included studies were published in peer-review journals (i.e., 85%) and the rest of them were published in Information Technology (IT) related conference proceedings (e.g., 2017 IEEE/ACM 4th International Conference on Mobile Software Engineering and Systems, or Proceedings of the IADIS International Conference Information Systems 2012). All journals or conference proceedings included in this study were distributed in the fields including medicine, technology and information system, and health IT.

### ***Co-authorship***

Researchers from 25 countries and 112 organizations contributed to the included articles. South Africa was the leading country contributing 23 publications and followed by Norway (i.e., 20 publications), and the United States (i.e., 14 publications) (Figure 4). Particularly, compared to other organizations, the University of Oslo (UO) contributed the most to the studies in terms of the number of publications, which has 17 publications included in this study (Figure 5).

Database	Date, # Results	Search Query
PubMed	03/01/2017, N = 68 02/22/2018, N = 24	("district health information system"[All Fields] OR (district [All Fields] AND ("health"[MeSH Terms] OR "health"[All Fields]) AND ("Information (Basel)"[Journal] OR "information"[All Fields]) AND system2[All Fields])) OR dhis[All Fields] OR dhis2[All Fields]
Scopus	03/05/2017, N = 263 02/22/2018, N = 45	TITLE-ABS-KEY ("district health information system" OR "district health information system2" OR dhis2 OR dhis)
WoS	03/01/2017, N = 117 02/22/2018, N = 37	TS = ("district health information system" OR "district health information system2" OR dhis2 OR dhis) OR TI = ("district health information system" OR "district health information system2" OR dhis2 OR dhis)
EBSCO	02/27/2017, N = 338 02/22/2018, N = 25	<ul style="list-style-type: none"> <li>● SU "district health information system" OR SU "district health information system2" OR SU dhis2 OR SU dhis</li> <li>● TI "district health information system" OR TI "district health information system2" OR TI dhis2 OR TI dhis</li> <li>● AB "district health information system" OR AB "district health information system2" OR AB dhis2 OR AB dhis</li> </ul>
IEEE Xplore	03/01/2017, N = 15 02/22/2018, N = 8	<ul style="list-style-type: none"> <li>● (((("Document Title": "district health information system") OR "Document Title": "district health information system2") OR "Document Title": dhis2) OR "Document Title": dhis)</li> <li>● (((("Abstract": "district health information system") OR "Abstract": "district health information system2") OR "Abstract": dhis2) OR "Abstract": dhis)</li> <li>● (((("Author Keywords": "district health information system") OR "Author Keywords": "district health information system2") OR "Author Keywords": dhis2) OR "Author Keywords": dhis)</li> </ul>
ACM Digital Library	03/01/2017, N = 0 02/22/2018, N = 0	<ul style="list-style-type: none"> <li>● acmdlTitle:(+"district health information system" +"district health information system2" +dhis2 +dhis)</li> <li>● recordAbstract:(+"district health information system" +"district health information system2" +dhis2 +dhis)</li> <li>● keywords.author.keyword:(+"district health information system" +"district health information system2" +dhis2 +dhis)</li> </ul>

Table 1. Search Strategy

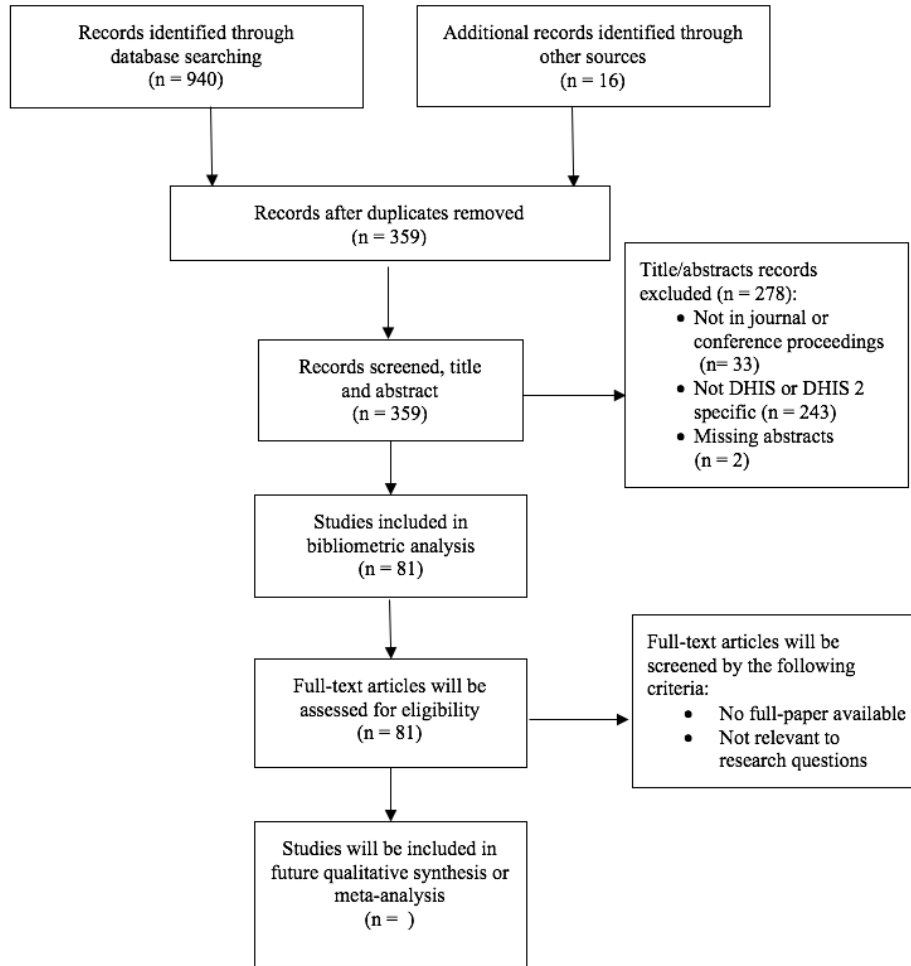
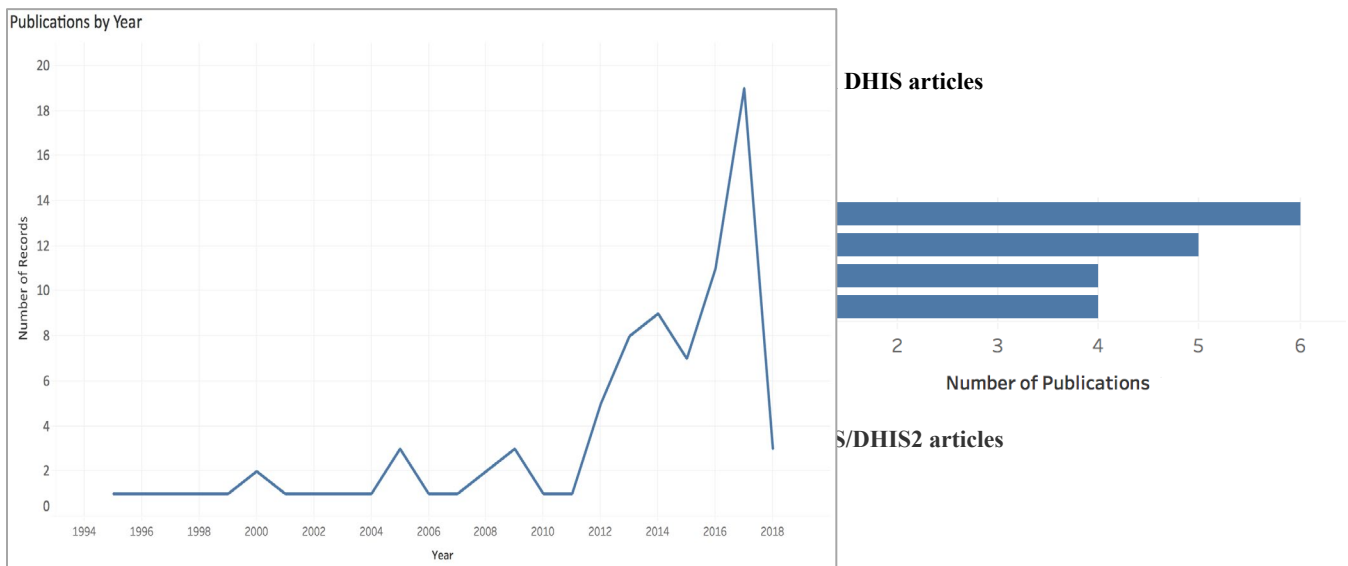
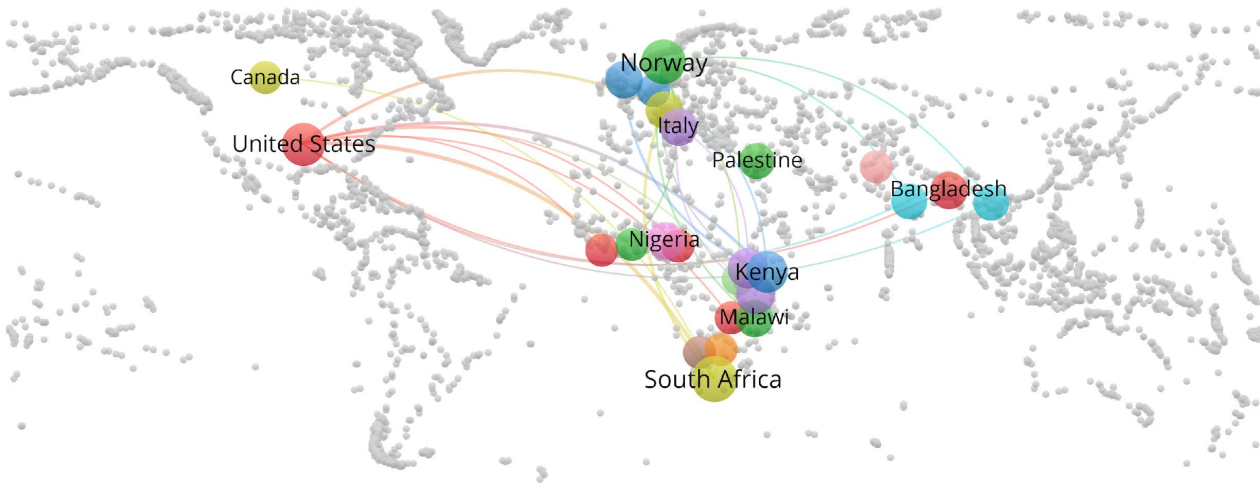


Figure 1. PRISMA flow diagram of study screening and inclusion

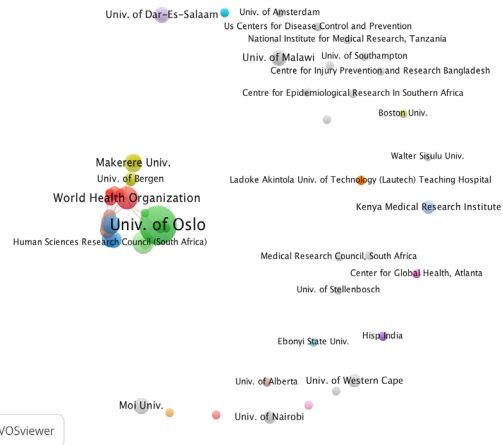




**Figure 4. Country collaboration visualization of DHIS/DHIS 2 publications**

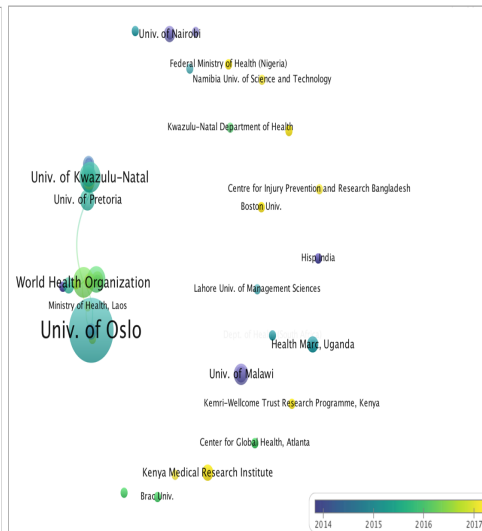
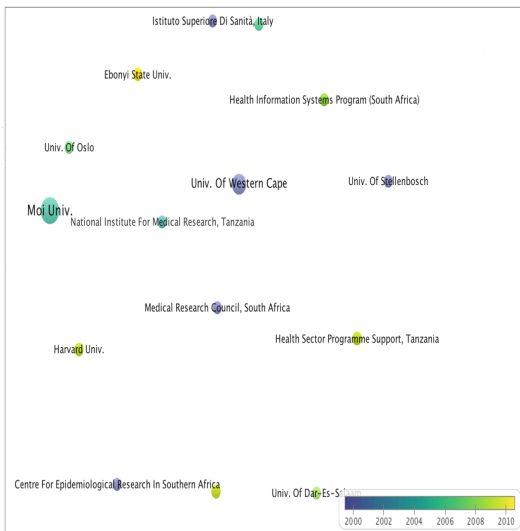
However, the research collaboration between the organizations was shown to be limited. For example, the University of Oslo collaborated with only 11 external organizations compared with over 100 organizations doing DHIS/DHIS 2 research in the world (Figure 5). On average, each organization examined in this study only collaborated with 3 other external units. Overall, the organization's collaboration network revealed a lack of broad collaborations across regions, countries, and institutes.

Further, the organization collaboration network with time overlay (Figure 6) illustrated that more DHIS/DHIS 2 studies were conducted after 2014 by disparate individual research organizations, such as the Center for Injury Prevention and Research Bangladesh, Eandk Consulting Firm in Kenya, Namibia University of Science and Technology, and Ministry of Health in Uganda, which implies that DHIS/DHIS 2 research uptake increased in LMICs since then.



VOISviewer

**Figure 5. The organization collaboration network visualization (\*each organization is represented by a colored node and labeled with the organization name. The size of the node correlates to the number of publications; the nodes in the same color belong to the same cluster/community; the distance between the nodes shows how closely two nodes collaborated together.)**



light: 2011-2018)

13 publications in this study. The citation impact which is measured by the number of publications received, the network map revealed that the research group of Barker, P.M., Eandk, W., and Rollins, N. has the highest citation impact over others underlining the importance of DHIS/DHIS 2 in LMICs (Figure 7). Other research works were highly cited

include Stoops, N. and Odhiambo-Otieno G. W.

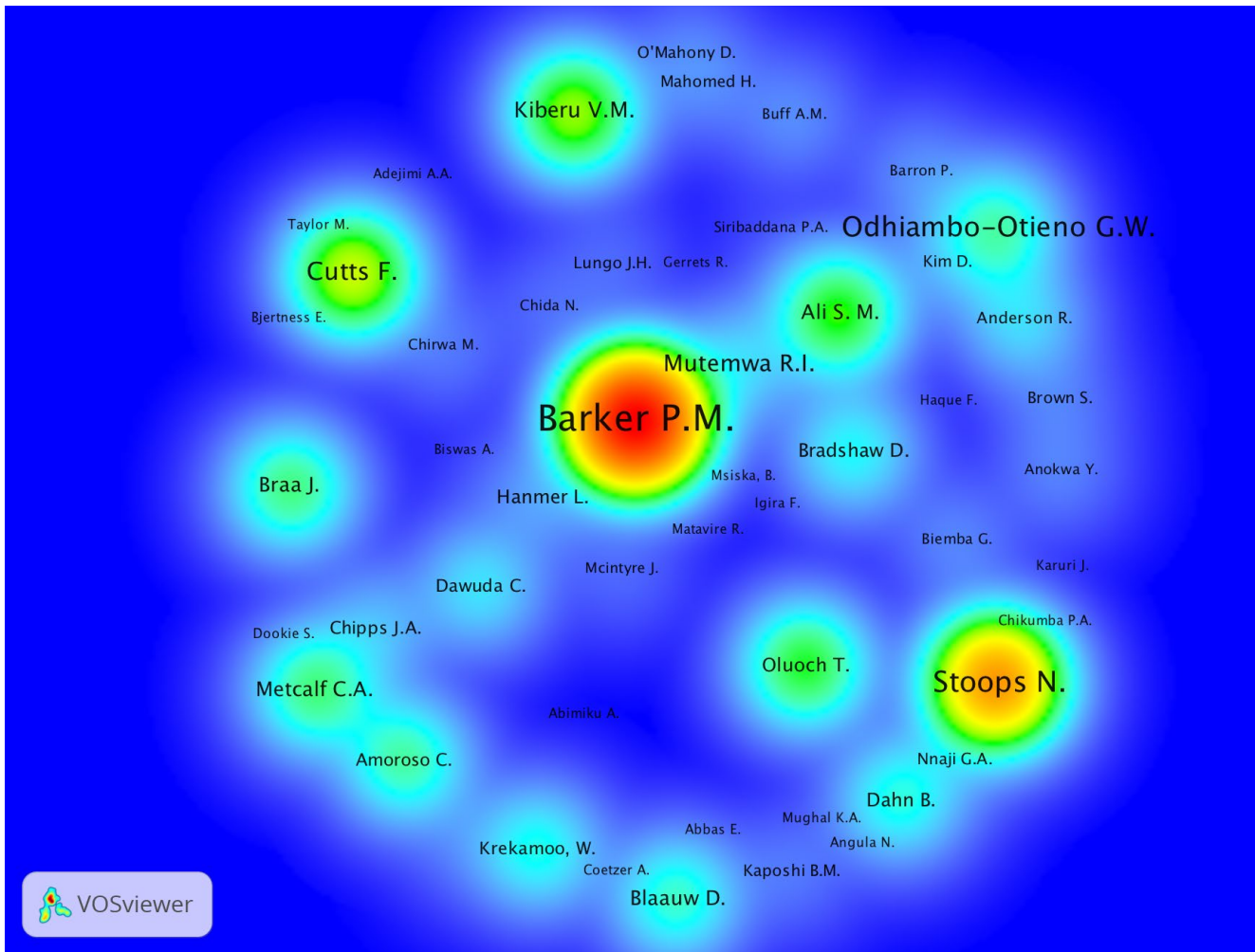


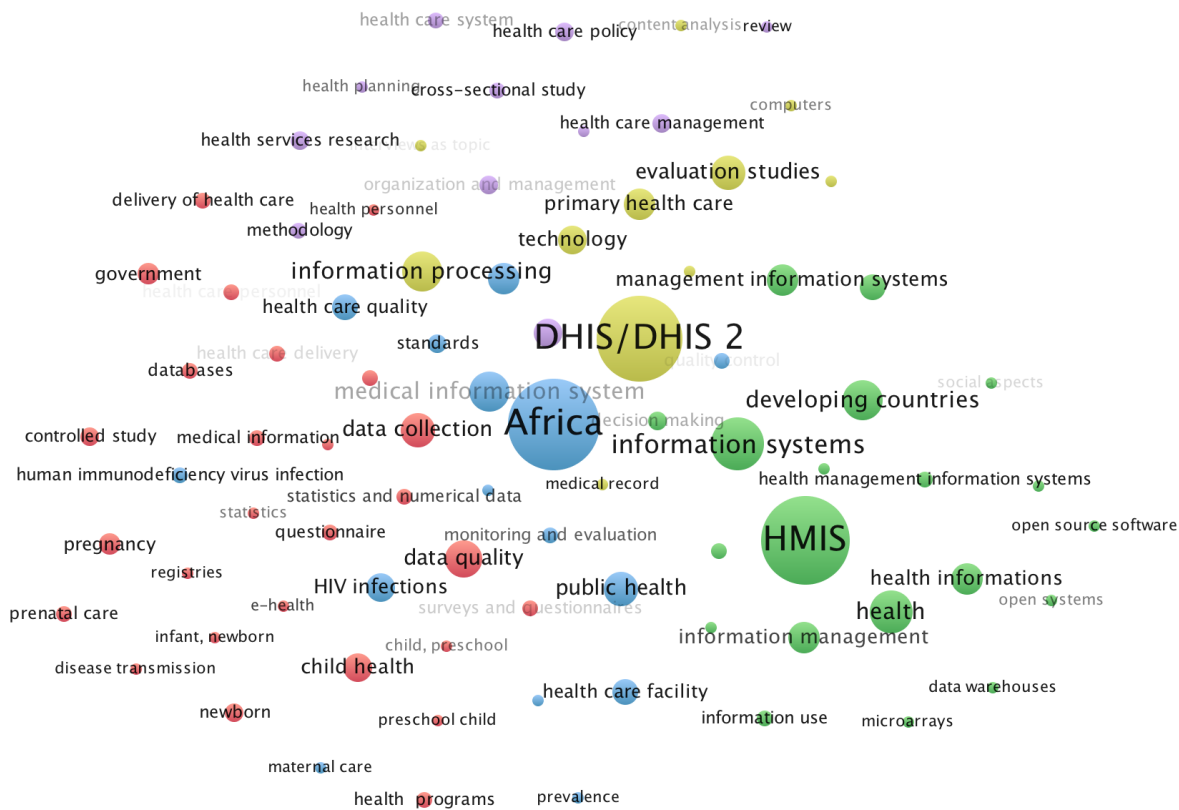
Figure 7. The citation impact visualization of authors (\*The authors' names in red, yellow, green, and blue areas correspond to these authors' citation impact from very high, high, low, to very low respectively; the authors' names in bigger font size correspond to higher citation impact and vice versa)



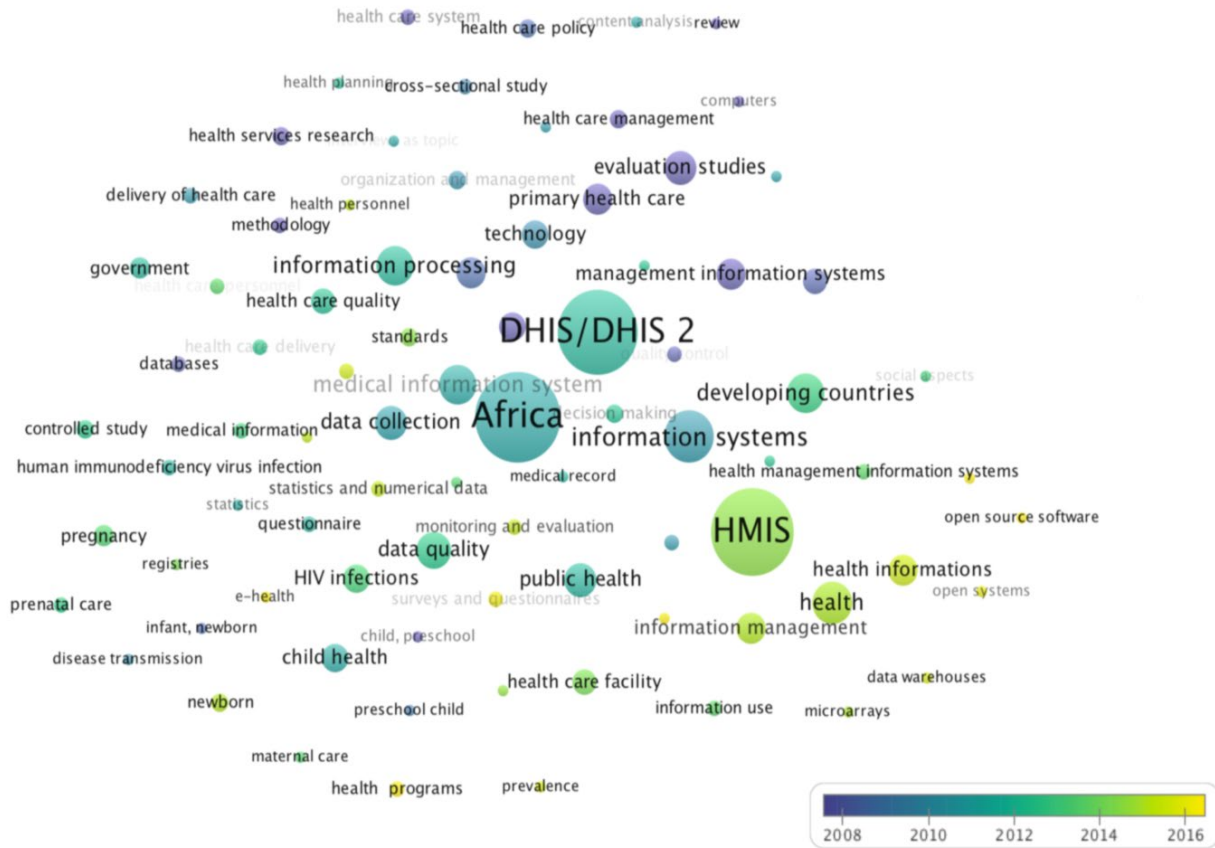
**Research Topics**

About 100 key terms that occurred more than three times were extracted from the title and abstract fields of included publications (Figure 8). The research topic network shows the research topics were distributed over four major categories: (1) the evaluation studies of DHIS/DHIS 2, such as in primary health care setting (i.e., yellow nodes); (2) data collection and quality in prenatal care, newborn care, and disease transmission (i.e., red nodes); (3) medical information system in Africa in terms of standards, facility, programs, and prevalence (i.e., blue nodes); (4) health management information systems in terms of information use, management, and open-source platform (i.e., green nodes).

Besides, recent DHIS/DHIS2 studies (i.e. after 2015) focused on topics of health management information systems (HMIS), particularly about open source software, interoperability, monitoring, and evaluation (Figure 9). While system integration and strategy issues are the keys to the adoption and use of digital health interventions in the adaptive healthcare systems (Sitting & Singh, 2010), other important issues about capacity building, IT infrastructure, funding, digital health impact on health outcomes were not addressed in “sufficient depth” in the examined publications even though IT infrastructure and skilled human resource drive adoption and usage in the low resource settings (Zhu, Kraemer, & Xu, 2006).



**Figure 8. The research topic network visualization (\*each key term is represented by a colored and labeled node. The size of the node correlates to the number of publications; the nodes with the same color belong to the same cluster/community; the distance between the nodes shows how frequently two nodes co-occurred)**



**Figure 9. The research topic time-overlay visualization (\*nodes in the dark green color are the topics appeared in publications before 2008; nodes in green and yellow are more recent topics addressed in publications after 2011)**

In many LMICs, technology infrastructure, Internet connectivity, power, and telecom connectivity, and skilled workforce are unevenly distributed with a high concentration in large cities or urban areas. Furthermore, the health information systems (HIS) there use a mix of paper and electronic systems for collecting, storing and analyzing health data (Braa et al., 2010), which are very different from the western world. However, this study identified the dominant role of western researchers (e.g., Braa, J., Nielsen, P, and Barker, P. M.) and organizations (e.g., University of Oslo) in conducting DHIS/DHIS2 research even though DHIS2 is primarily adopted and used by LMICs. Although individual researchers and organizations in LMICs have been participating in DHIS2 studies, contributing to the research outcomes, and even a few of them had significant citation impact (e.g., Mphatswe, W., & Rollins, N.), their overall research productivity and influence was far less than peers in western countries. Besides, there is a lack of broad research collaborations between the organizations in western countries and LMICs, and among organizations within LMICs.

Nevertheless, the application of contextual frameworks to enhance adoption and use of health IT such as DHIS2 is

critical to reducing the design-reality gap (Heeks, 2006) in HIS development and implementation. Therefore, this study advocates the efforts aimed at developing HIS frameworks that are aligned with the local health system context in LMICs and addresses the design-reality gap by emphasizing the need to generate evidence by local researchers in LMICs.

**Limitations**

Articles included in this study were selected from the retrieved articles indexed by six citation databases. There might be highly relevant articles published in journals that were not indexed by these citation databases. Besides, this study did not search or include grey literature such as technical reports, master theses, or doctoral dissertations addressing DHIS/DHIS 2 issues in this phase of the study. For example, the HISP at the University of Oslo has been dedicated to disseminating training and research resources to the collaborators in LMICs, and the students there have focused on improving DHIS 2 implementation by studying issues of data quality, architecture, capacity, add-on applications, and deployment support. There is a discrepancy between the number of our included articles and the number of publications that HISP has been tracking and curating (PATH, 2016, p. 33). Therefore, future studies shall

search and include relevant works from grey literature and HISP self-tracked publications, especially the ones deliberately published in journals that are readily accessible to researchers in LMICs, together with studies involving primary data collection. Such studies will help build an in-depth understanding of the factors driving or hampering adoption and the use of DHIS 2 to improve health outcomes. In addition, citation data were aggregated from six databases and the citation impact analysis was based on the citation counts provided by Scopus and WoS. If a publication was not indexed by Scopus or WoS, its citation count was not available, which may lead to bias in author citation-impact analysis.

## Conclusion

With the increasing adoption and use of global digital health interventions such as DHIS/DHIS 2, there is a growing need for national governments, international organizations, and donors to prioritize research topics and strengthen research capacity in LMICs to generate evidence pertinent to adoption and use of digital health for improving health outcomes. This exploratory study is an initial attempt at identifying gaps and underlining the need for research studies investigating the impact of digital health. As a next step, we plan to include grey literature and conduct a qualitative analysis of screened publications with a goal to i) identify priority research areas for improving functionalities in the software platform, ii) design interventions aimed at strengthening inter-institutional collaboration, iii) develop contextualized digital health research courses, and v) develop appropriate metrics for measuring impact of digital health interventions on health outcomes while building on the digital health taxonomy of the World Health Organization.

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# Is there a mantra for successful collaboration? Mapping faculty experience in facilitating cross-culture collaboration

**Naresh Kumar Agarwal**  
Simmons University, USA  
agarwal@simmons.edu

**Noor Faridah A Rahim**  
Temasek Polytechnic,  
Singapore  
faridah@tp.edu.sg

## ABSTRACT

A number of studies have looked at the benefits of collaboration. However, very few studies have documented the experiences of faculty collaborators in the process. In Fall 2012, two instructors from Singapore and USA collaborated to facilitate cross-cultural interaction between their students to provide feedback on each other's assignments. Using an action research framework, this self-reflective paper looks at the process of faculty collaboration and the experiences of the instructors in facilitating the student interaction. The objectives of this paper were to investigate the enabling conditions and challenges, the stages involved, and the tools and technologies required in ensuring successful collaboration between remote instructors. Using an action research framework, the findings are mapped to four stages – plan, act, observe and reflect. The main contribution is a framework for action research for instructor collaboration. The findings and the framework should be useful both for instructors seeking to collaborate for research and to facilitate collaboration between their students, as well as practitioners of action research. The paper should also help further research on collaboration and collaborative information behavior.

## Keywords

Remote collaboration, action research, email, audio conferencing, cloud computing

## Introduction

Research thrives both on individual work and on collaboration. Faculty often collaborates with researchers from within or across other institutions. However, there are very few studies that have documented the individual reflections and journey of collaborators in the process of initiating and continuing with a successful collaboration, which might be helpful to other re-searchers – especially in the context of collaboration between educators for teaching-related research. This study documents the process of collaboration between two remote instructors. The collaborators were based in locations far from each other – Singapore and USA, and were instructors in their respective

schools. They wanted to get their respective students to engage with each other, and document their own reflections in the process of collaborating. Using an action research framework, this paper presents the authors' experiences and reflections on their collaboration journey. The specific research questions examined are, "What are the 1) enabling conditions and challenges, 2) the stages involved, and 3) the tools and technologies required in ensuring successful collaboration between remote instructors. The theoretical lens used for the study is the action research model adapted from Riding, Fowell, and Levy (1995) and Yasmeeen (2002). These findings are mapped to the four stages – plan, act, observe and reflect in the action research framework. The contribution of our paper is a set of findings and an action research framework for instructor collaboration that could be helpful for other researchers and faculty members seeking to collaborate with other remote instructors or researchers. The paper adds to the literature on action research and remote and cross-cultural collaboration between instructors and/or researchers.

## Literature review

### *Collaboration*

There is a huge body of literature on collaboration – spanning business and organizations (Gray, 1989), healthcare (e.g. Croker, Trede, & Higgs, 2012 on collaboration in rehabilitating teams), and scholarly and education contexts (e.g. Cook, & Friend, 1995; McDuffie, Mastropieri, & Scruggs, 2009; and Rytivaara & Kershner, 2012 on co-teaching; Kimmel, 2012 on librarian-teacher collaboration).

*Definitions.* Gray (1989) describes the collaboration as the constructive management of differences and a process in which those parties with a stake in the problem actively seek a mutually determined solution. "They join forces, pool information, knock heads, construct alternative solutions, and forge an agreement." (p.xviii). Mattessich, Murray-Close, & Monsey (2001) define collaboration as "a mutually beneficial and well-defined relationship entered into by two or more organizations to achieve common goals" (p.4). Highlighting the importance of two heads being better than

one, Shah (2012), in his book on collaborative information seeking, investigates collaborative processes that are “intentional, interactive, and possibly mutually beneficial.” (p.4). Shah (2012, p.4) defines collaboration as “an activity of multiple parties coming together to work toward a mutually beneficial common goal.” He cites the example of (one side of a) tug-of-war, where every individual in the team is contributing one's strength to pull the rope in a particular direction to win the game. Even though the team might have a captain, “but when it comes to working on the collaborative task (pulling the rope), everyone is contributing more or less the same.” “Thus, the real authority lies in the collaboration rather than in individuals.” (p.4). Thus, the emphasis of this definition is in the process of knowledge sharing and working towards a common goal. Kemp (2013) highlights the biggest advantage of collaboration as exposure to new ideas, methodologies, and insights. The disadvantages of collaboration include over-specialization, selflessness leading to self-defeating behavior and anonymity (Kemp, 2013).

*Factors affecting collaboration.* Continuing from the previous example, let us consider a scenario where a member of a team in tug-of-war is not as interested in winning or decides to give up mid-way? Thus, there are factors that need to be understood as to what makes a successful collaboration. Based on a review of the literature, Mattessich, Murray-Close, & Monsey (2001) identify several factors that make successful collaboration. These factors are related to the environment, membership characteristics, process, and structure, communication, purpose, and resources. A successful collaborative relationship “includes a commitment to mutual relationships and goals, a jointly developed structure and shared responsibility, mutual authority and accountability for success and sharing of resources and rewards” (Mattessich, Murray-Close, & Monsey, 2001, p.4). Martin-Rodriguez, Beaulieu, D'Amour, & Ferrada-Videla (2005) synthesized the factors affecting successful collaborations in health care teams, as identified by theoretical and empirical studies in the area. The factors include processes at work in interpersonal relationships within the team (*interactional determinants* – willingness to collaborate, trust, communication, and mutual respect), conditions within the organization (*organizational determinants* – organizational structure, organization's philosophy, administrative support, team resources, and coordination and communication mechanisms), and the organization's environment (*systemic determinants* – social system, cultural system, professional system, and educational system). Shedding further light on the interactional determinants identified by Martin-Rodriguez *et al.* (2005) and discussed above, Culbertson (2013) did a study on the qualities of the best research collaborator based on responses by 7 individuals who had experienced collaborative work with others.

The qualities identified include complementing skills and interests, personality traits such as being a good person who is trustworthy, respectful, open-minded and motivating with the ability to give and receive constructive criticisms, knowledgeable and with great ideas and perspectives, and who has experienced working with others. Dahlander & McFarland (2013) highlight homophily or the tendency of people to select collaborations with others similar to themselves as a salient factor for research collaboration. People tend to associate and collaborate with others when they share attributes of age, gender, education and ethnicity (Dahlander & McFarland, 2013).

*Dimensions of collaboration.* Taylor-Powell, Rossing, and Geran (1998) distinguish collaboration from other terms – communication, contribution, coordination, and cooperation. They define communication as a process based on the exchange of information and meaning, and crucial for a productive relationship. Contribution or mutual support is defined as an informal relationship through which parties help each other by providing some of the resources and support needed to reach their independent goals. Coordination is seen as a deliberate, joint, and more formalized relation among parties involving communication, some planning, and division of roles, longer-term goals, and sharing of resources and risks/rewards to achieve complementary goals. Current activities are adjusted for more efficient and effective results. Cooperation is defined as a relationship in which parties with similar interests plan together, negotiate mutual roles and share resources to achieve joint goals. Each party maintains its own identity.

Finally, in collaboration, the parties develop a shared vision, build an interdependent system to address issues and opportunities and share resources. Authority is vested in the collaborative, rather than in individuals or an individual agency. The difference between these five Cs is in the level of integration – the lowest integration being in a communicative relationship and the highest in a collaborative one. Shah (2012) explains these as a set-based model where collaboration is the superset of cooperation, the cooperation of coordination, and so on. Thus, for successful collaboration to occur, it must involve all the other Cs i.e. cooperation, coordination, contribution, and communication.

Crocker, Trede, and Higgs (2012) carried out a phenomenological study to study the experiences of healthcare workers collaborating within rehabilitation teams. They interviewed 66 team members across 9 teams. Crocker *et al.* discovered 8 dimensions of collaborating experiences, 5 of which were interpersonal and 3, what they called reviewing dimensions. As per the authors, these dimensions represent the essence of the lived experience of collaborating in rehabilitation teams (rather than representing experiences of particular disciplines). The

interpersonal dimensions of collaboration experience identified were: 1) engaging positively with other peoples' diversity (self in relation to others); 2) entering into the form and feel of the team (in relation to team membership changes; in our study, there were only 2 collaborators, so this was not an issue); 3) establishing ways of communicating and working together (highlighting complexities of interacting with others); 4) envisioning together frameworks for carrying out the task at hand (sharing expectations and information) and 5) effecting changes in people and teams (also not applicable to our study). In addition, they also identified 3 reviewing dimensions of the experience of collaborating that operated across the dimensions above: 6) reflexivity (involving critical reflection and development of self in relation to others); 7) reciprocity (enabling mutuality of rehabilitation roles), and 8) responsiveness (facilitating situation-appropriate and contextually-relevant adjustments).

### ***Action Research/Theoretical Lens***

Riding, Fowell, and Levy (1995) define action research as a systematic and reflective research method that allows participants to plan, observe, analyze and reflect on their experiences. The reflective and analytical insights of the researcher-practitioners themselves form the basis of the developmental process. It is participative and allows participants to contribute equally to the research inquiry (Riding, Fowell, & Levy, 1995). Through a systematic process of using theoretical developments to improve curriculum design and delivery, action research methodology motivates educators to incorporate innovative teaching and learning. This is done by placing the educator in the dual role of the educational theory producer and user as well (Riding, Fowell, & Levy, 1995). This helps produce knowledge and improve learning and teaching practice, thereby blending design with the delivery of teaching while simultaneously filling the gap between theory and practice.

This also encourages educators to holistically integrate their research and teaching interests, leading to greater job satisfaction, enrichment of academic programs, enhancement of student learning and practitioner's insights and contributions to the advancement of knowledge in higher education (Riding, Fowell, & Levy, 1995; Zuber-Skerritt, 1982, p.15 as cited by Riding et al.). In action research, "no separation need be made between the design and delivery of teaching, and the process of researching these activities, thereby bringing theory and practice closer together." (Riding, Fowell, & Levy, 1995, para. 7).

Figure 2 shows an action research framework. The framework consists of 4 stages – plan, act, observe and reflect (or learning from evaluation) that researchers go through in the process of conducting action research. The insights gained from the initial cycle feeds into the planning of the second cycle, where the action plan is modified and

the research process repeated (Riding, Fowell, & Levy, 1995). Zuber-Skerritt (1982) describes action research as a critical collaborative inquiry by reflective practitioners who are accountable in making the results of their inquiry public, self-evaluative in their practice, and engaged in participative problem-solving and continuing professional development. We use the action research framework of Figure 2 as a theoretical lens in this study.

### ***Collaboration and Action Research***

We have looked at various definitions of collaboration, factors affecting collaboration and the dimensions of collaboration identified in prior studies. There are very few studies that bring together collaboration and action research. Barbara Gray (1989) describes the collaboration as a three-stage process. These stages are synthesized by London (2012). The first and most difficult stage is the problem-setting phase. Here, the parties arrive at a shared definition of the problem, make a commitment to collaborate and determine the resources needed for the collaboration to proceed. In the second direction-setting phase, the collaborators set the agenda and identify the interests that brought them to the table, determine how they differ from the interests of others, explore pros and cons of various alternatives, set directions and establish shared goals, reaching an agreement on a course of action. In the third and final implementation phase, the collaborators establish structures for implementation monitor the agreement and ensure compliance (Gray, 1989; London, 2012). The problem-setting and direction-setting phases of Gray (1989) correspond to the 'plan' stage of the action research framework of Figure 2. Gray's implementation phase corresponds to the 'act' and 'observe' stages of the action research framework.

Research on collaboration for education and research have covered issues related to incorporating multi-cultural factors such as local cultures, and socioeconomic and psychological issues into the designing and teaching of online courses across borders. Riding, Fowell, & Levy (1995) describe the nature and usage of action research in on-going development and evaluation of a new undergraduate module to improve teaching and learning practice. Whatley & Bell (2003) discuss the outcomes of an online discussion and exchange of feedback between groups of students from different countries, different experiences and learning goals. Their study highlighted the potential complexity of such an asymmetric collaborative activity but indicates several advantages to students when such activity forms a part of the pedagogical framework of their modules. Thus, action research collaborative learning creates a more interdependent learning community arising from the extension of the individual learning communities and their learning resources (Whatley & Bell, 2003). Bowl, Cooke, & Hockings (2008) discuss the challenges of conducting action research in higher education within a multi-dimensional

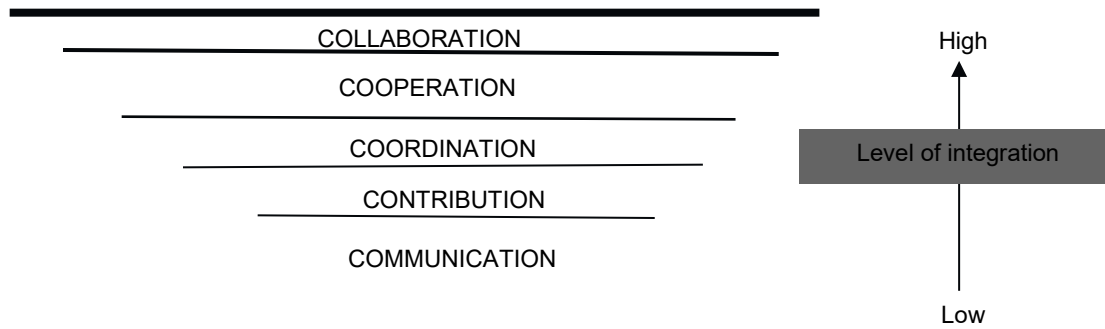


Figure 1. The 5 Cs in reaching the optimal goal of collaboration (adapted from Taylor-Powell, Rossing, & Geran, 1998; Shah, 2012)

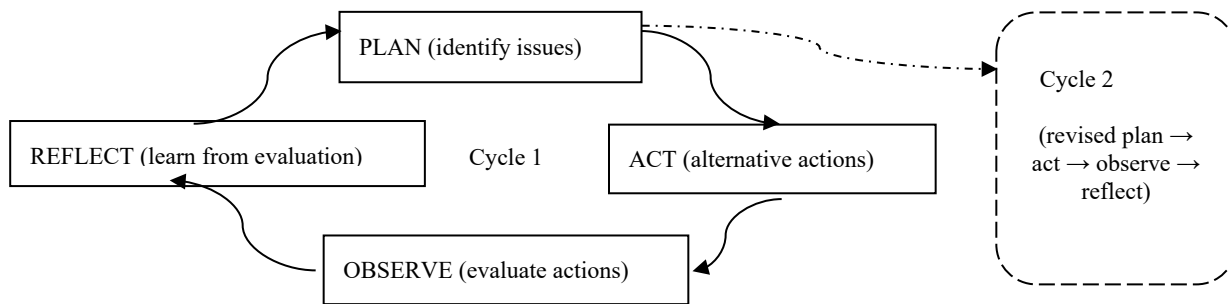


Figure 2. Action research framework – adapted from Riding, Fowell, & Levy (1995) and Yasmeen (2002)

framework across boundaries and borders. These challenges include different philosophies underlying academic engagement, institutional and sector diversity and different geographical locations. These touch upon the interactional, organizational and systemic factors affecting collaboration, as synthesized by Martin- Rodriguez et al. (2005) from prior research. Bowl, Cooke, and Hockings (2008)' study conclude that it is useful for research teams to use the process of reflection-in-action to reflect on issues related to research methodology and differences in carrying out research in different institutional settings (Bowl, Cooke, & Hockings, 2008). Yasmeen (2008) also concludes that action research can be adopted at all educational levels to improve teaching and learning outcomes.

Thus, while there have been a large number of studies investigating the phenomenon of collaboration and its application in various contexts, there is not much work involving collaboration for action research by instructors/researchers based in remote locations, especially in the context of the US and Singapore. There is no standard template for potential collaborators to follow should they want to initiate collaboration in a process where they want to get their students to collaborate in turn. Thus, a study is needed to investigate the enabling conditions and challenges, the stages involved, and the tools and technologies required

in ensuring successful collaboration between remote instructors. This is especially pertinent keeping in mind cloud computing and audio conferencing technology solutions that are now available for use by instructors. The study will also compare the findings with the determinants and dimensions of collaboration identified in prior studies, and see if it applies to an educational context as well.

### Methodology

To address the research questions for the study, the authors conducted the study based on the stages of the Action Research Framework depicted in Figure 1 above, which serves as the theoretical lens. The unit of analysis is the authors (researchers) themselves. As suggested by Riding, Fowell, and Levy (1995) and other past studies on action research, the study adopted a methodical, iterative approach embracing problem identification, action planning ('plan'), implementation ('act'), evaluation ('observe') and reflection ('reflect' or 'learn from evaluation'). Furthermore, this research had a number of features distinctive of action research, as listed by Zuber-Skerritt (1982). Table 1 lists the salient features of action research as it applies to this paper.

To capture the process of instructor collaboration, the authors relied on a few sources:

- 1) The string of emails that the authors had exchanged during the entire course of their collaboration.

These emails served as an archive of all the exchanges that took place in the process. The emails were analyzed by date, the direction of exchange (from Singapore to the US or vice-versa), and the content of the exchange.

2) The Dropbox folders that served as a repository of all documents and deliverables produced at various stages of the collaboration. The timestamps associated with the files in Dropbox were analyzed concerning the email ex-change, to arrive at the trail of communication and the deliverables that resulted from that communication.

3) There was no direct data logged from the synchronous Skype calls, as the calls were not recorded. However, notes from the calls and summaries based on the discussion were part of files in Dropbox or exchanged in emails, which served to highlight the content of discussion in specific Skype calls. The dates and times for specific Skype calls were retrieved from the emails, as well as from

the Google and Microsoft Outlook calendars used by the co-authors.

4) Finally, a retrospective reflection of the collaborative process was employed by both the authors and their notes compared. These reflections (as well as the outputs of the emails and the Dropbox files) were analyzed concerning the respective stage of the theoretical framework (plan, act, observe or reflect) that they best fit into.

All these served as the data for the study. The findings were also analyzed using Anderson & Herr (1999)'s criteria for action research, to ensure that the study had been done rigorously and effectively.

<b>Keywords pertaining to action research (Zuber-Skerritt, 1982):</b>	<b>Description by Riding, Fowell &amp; Levy (1995), para. 11</b>	<b>Application in this study</b>
<i>Critical</i>	“practitioners not only look for ways to improve their practice within the various constraints of the situation in which they are working, but are also critical change agents of those constraints, and of themselves.”	Both the co-authors embarked on the collaboration to add value to their teaching and to help their students learn to work virtually with people in different cultures – a key skill in today’s workplace. The project was carried out within the confines and requirements of the courses they were already teaching. The first author actively discussed the project as part of a year-long faculty seminar.
<i>Reflective</i>	“participants analyse and develop concepts and theories about their experiences.”	The research questions of this study, as well as the analysis and findings, address concepts and theories about the authors’ experiences.
<i>Accountable</i>	action researchers “aim to make their learning process and its results public, both to each other and to other interested practitioners, using accessible terminology.”	One of the purposes for this reflection and dissemination is to provide a template for other interested instructors to collaborate for action research involving their students.
<i>Self-evaluative</i>	“the reflective and analytical insights of the researcher-practitioners themselves form the basis of the developmental process.”	The analysis and findings of this paper is based on self-reflection by the two authors.
<i>Participative</i>	“those involved contribute equally to the inquiry”	Both the authors were highly invested in the success of this project and have contributed equally to addressing the research questions of this study and to this paper.
<i>Collaborative</i>	“the researcher is not an expert doing research from an external perspective, but a partner working with and for those affected by the problem and the way in which it is tackled.”	As opposed to studying other research participants, subjects or respondents, the authors (researcher-instructors) were studying themselves and their processes and deliverables in the course of carrying out this collaborative project.

**Table 1. Salient features of action research as it applies to this paper**



### **Case description – what we collaborated on**

In early 2012, the authors got in touch with each other over email to discuss the possibility of collaboration, and to get their respective students to engage with each other. The two authors were based more than 9000 miles from each other – in Temasek Polytechnic, Singapore and Simmons University (then College), Boston, USA, and had never met. They were teaching in two very different institutions, in separate educational disciplines, and to students who were vastly different in age and educational level. Was collaboration, then, even likely or feasible? They spent the next few months in interaction over email and audio conferencing (Skype) discussing how they might collaborate. Most of the initial interaction was asynchronous (over email). As the collaboration progressed, synchronous interaction between the authors was achieved using Skype.

After the initial rounds of discussion, the authors settled on the specific areas of collaboration in Fall 2012. Considering the differences between students and the constraints of time and distance, the authors decided that it might be best to get their respective students to evaluate and provide feedback on each other's assignments. They decided to explore how incorporating cross-country student interaction using Facebook into their respective courses impacts student learning and satisfaction. The Singapore-based author was teaching a cross-disciplinary course 'Effective Internet Research' to 10 classes with a total of 238 students. The course was offered by Temasek Polytechnic. The US-based author was teaching the 'Technology for Information Professionals' course to 2 classes with a total of 58 students. The course was offered at Simmons University (then College) to Masters-level students. The Singapore students had to work on an assignment whereby they had to work in teams to come up with Facebook advocacy pages on an assigned socially-relevant topic such as human trafficking, social justice, youth depression, mobile gaming, internet addiction, etc. Each team had to set up their Facebook page to publicize their group's research findings and to garner feedback from the online community.

One of the assignments the US students had to work on was creating a comprehensive personal website/web portfolio featuring personal and professional aspects of their lives. The US and Singapore students differed in a number of ways: 1) type of school (Polytechnic versus Graduate school); 2) discipline (cross-disciplinary versus Library and Information Science); 3) types of assignment; 4) age (the Singapore students were much younger), and 5) culture, and considering the geographical distance and the virtual nature of collaboration over Facebook.

Facebook was chosen as the platform for the students to collaborate (as the Singapore students already had an assignment that required the use of Facebook). Since the Singapore students were going to be creating Facebook

pages, a designated area could be created within those pages (named 'collaborative peer review', though, being from different institutions, they were technically not peers) whereby 1-2 US students were to collaborate with a team of 4-5 Singapore students. While the purpose of the collaboration was simple i.e. to evaluate and to provide feedback on each other's assignments, students were encouraged to get to know one another. The students were provided with a set of criteria based on which to evaluate each other's respective assignments. For the Singapore students, the graded Facebook activity constituted 10% of their continual assessment component. For the US students, the Singapore collaboration was 5% of their grade for the web portfolio assignment. The duration of the collaboration between the students was 1-2 weeks.

The objective was to gather insights into the challenges, effectiveness and student perceptions of such a collaboration, and also to prepare students for working with people separated by geography – an increasing reality in workplaces. The study was designed and approved by the Institutional Review Board / Ethics Committee of the respective schools.

Along with face-to-face briefing, both sets of students were given detailed written instructions about their assignments, as well as the collaboration with their virtual collaborators. During the collaboration week(s), the US students (a single or at most two students) assigned to each team of Singapore students posted a self-introductory note about themselves, together with the link to their website which they had created as part of their course deliverable and an invitation for the Singapore students to review their websites. Singapore students visited their collaborators' websites and provide constructive comments and critique. The USA students provided their feedback and critique about their Singapore collaborators' Facebook pages.

### **Data analysis**

It is difficult to make a clear distinction between data gathering and data analysis in qualitative research (Agarwal, Poo, & Tan, 2007). Thus, both data gathering and analysis go hand-in-hand. The theoretical framework used for the analysis is based on Riding, Fowell, and Levy (1995) and Yasmeen (2002). See Figure 1. The data in question here is the reflection of the authors on their collaboration for this project, as well as an analysis of their interaction, documents generated and tools/technologies used. The tools/technologies used to support the collaboration included an online voice and chat software application (Skype), a cloud sharing application (Dropbox) and basic email applications (Microsoft Outlook and Gmail).

Table 2 below summarizes the email interaction between the researchers in each phase of the action research framework. Only emails exchanged in the first seven months of the collaboration (when the majority of the work was carried

out) have been analyzed. The details of the contents of each email were analyzed but not presented due to organizational sensitivities associated with emails.

	Months	No. of emails exchanged	Contents
<i>Plan</i>	Jun 2012	SG → US: 5 US → SG: 8	<ul style="list-style-type: none"> <li>▪ Outreach for possible collaboration; expression of interest to collaborate</li> </ul>
	Jul 2012	SG → US: 2 US → SG: 3	<ul style="list-style-type: none"> <li>▪ discussion to firm up the collaborative project proposal; initial submission to institutional review board in the US</li> </ul>
	Aug 2012	SG → US: 10 US → SG: 8	<ul style="list-style-type: none"> <li>▪ planning of the student's collaboration e.g. scheduling of dates</li> <li>▪ finalizing of syllabus and teaching plans</li> <li>▪ discussion on the appropriate social media tools for students to use to evaluate and provide feedback on each other's course assignments e.g. Wiki, Twitter, Facebook</li> <li>▪ discussion on communication tools for authors (researchers) to use to discuss on details of the collaboration</li> <li>▪ setting up and exchanging of Skype and Dropbox accounts</li> <li>▪ scheduled first Skype conference call Friday 31 Aug 2012 at 10pm Singapore time and 9am US Eastern time.</li> </ul>
	Sep 2012	SG → US: 12 US → SG: 13	<ul style="list-style-type: none"> <li>▪ assignment evaluation/feedback idea for student collaboration</li> <li>▪ Drafts of assignments for US and Singapore students</li> <li>▪ references for main study</li> <li>▪ questionnaire for main study</li> <li>▪ appointment for Skype conference calls (Friday Sep 14 and Sep 21 at 10pm Singapore Time; 9am US Time)</li> </ul>
<i>Act</i>	Oct 2012	SG → US: 4 US → SG: 5	<ul style="list-style-type: none"> <li>▪ Project briefs / assignment sheets finalized for both US and Singapore students and distributed to students</li> <li>▪ Incorporation of evaluation criteria for websites developed by US students and Facebook pages by Singapore students</li> <li>▪ Singapore researcher set up a test page on Facebook site for the US researcher's comments and feedback</li> <li>▪ Agreement to submit research paper to an overseas conference</li> </ul>
<i>Observe</i>	Nov 2012	SG → US: 8 US → SG: 4	<ul style="list-style-type: none"> <li>▪ Set up Skype conference calls on Friday November 2 and Saturday November 10 at 10pm Singapore time and 9am USA time</li> <li>▪ Singapore students' research groupings uploaded via Dropbox</li> <li>▪ Preparing the IRB and ethics committee documents for both schools</li> <li>▪ Designing the main study questionnaire</li> <li>▪ Week(s) for collaboration between US and Singapore students</li> <li>▪ Authors addressed issues relating to specific students including missing website links, inadequate Facebook resources, missed allocation of partners, dislocation of Facebook posts</li> </ul>
<i>Reflect</i>	Dec 2012	SG → US: 14 US → SG: 14	<ul style="list-style-type: none"> <li>▪ Final editing and confirmation of the IRB and ethics documents</li> <li>▪ Approval of IRB documents</li> <li>▪ 1st batch of main survey data completed by US students who have just ended their course</li> <li>▪ Reorganization of Dropbox folders</li> <li>▪ Appointment for a Skype conference call on 7 Dec 2012 to discuss on finalizing the overseas conference paper</li> </ul>
<i>Cycle 2</i>			<ul style="list-style-type: none"> <li>▪ Working on data analysis and finalizing journal articles; Implementing Cycle 2 during the next phase of the collaboration in the Oct 2013 semester by incorporating the observation and reflection phase of Cycle 1</li> </ul>

**Table 2. The email interaction in each phase of the Action Research Framework**

	Month (2012)	Skype calls (date, time)	Duration	Content of Discussion / Deliverable in Dropbox folder
<i>Plan</i>	Jul			Setting up of Dropbox and Skype connections <i>Dropbox</i> : Initial IRB submission to US school

	Aug	Friday Aug 31 (10pm SG, 9am US time)	1 hour	Nature of collaboration, subjects for collaboration, instruction sheets
	Sep	Friday Sep 14 (10pm SG, 9am US time)	1.5 hours	Details of collaboration, teaching plan schedules, technology tools to use, student groupings <i>Dropbox:</i> Subject syllabi, teaching plans, research topics
		Friday Sep 21 (10pm SG, 9am US time)	1.5 hours	Discussion of paper for journal <i>Dropbox:</i> draft versions of assignment briefs, questionnaire design
<i>Act</i>	Oct	No Skype call		<i>Dropbox:</i> final versions of assignment briefs, IRB documents; students' groupings by names and classes
<i>Observe</i>	Nov	Friday November 2 (10pm SG, 9am US time)	2 hours	IRB ethics documents; setting up of students' collaboration sections via Facebook; presentation at conference
		Saturday Nov 10 (10pm SG, 9am US time)	2 hours	Questionnaire for main study to be submitted to IRB <i>Dropbox:</i> reference research papers
<i>Reflect</i>	Dec	Saturday Dec 1 (11pm SG, 10am US time)	2 hours	Drafting of the conference paper <i>Dropbox:</i> reference research papers for conference paper
		Tuesday Dec 11 (11.30pm SG, 10:30am US time)	2.5 hours	Reorganization of the conference paper <i>Dropbox:</i> drafts of the conference paper, final version of the IRB documents
<i>Cycle 2</i>				Implement Cycle 2 during the next phase of the collaboration in the Oct 2013 semester by incorporating the observation and reflection phase of Cycle 1

**Table 3. Skype calls and deliverables in Dropbox for each phase of the Action Research Framework**

After looking at the raw data of the paper, let us briefly summarize the author experiences in the collaborative process. Table 4 below details the authors' experiences when conducting action research for this collaboration, using the Action Research Framework adapted from Riding, Fowell, & Levy (1995) and Yasmeen (2002).

<i>Plan</i>	Planned a collaborative strategy and devised resources and processes to support it. The authors did three months of advanced planning starting July 2012 for the implementation of the collaboration in October 2012. This phase involved careful planning of their respective subject teaching plans to schedule the actual dates for the collaborative feedback process to take place virtually via Facebook during the weeks of November 12–15 and November 26-30 in 2012, developing the research themes, and setting up and testing the Facebook site for the subject.
<i>Act</i>	Put the planned collaborative strategy into practice by incorporating it into the delivery of subjects Effective Internet Research (for Singapore students) and Technology for Information Professionals (for USA students). All interaction by the instructors with their respective set of students with regard to the collaborative project was discussed with each other, and any changes decided upon. This interaction with students included a briefing about the social-cultural backgrounds of the remote students, urging them to exchange greetings and self-introductory posts on Facebook, and helping manage student expectations on both sides. The authors allocated time slots (mainly on Fridays – 10 pm Singapore time and 9 am USA Eastern time) for online voice chat over Skype, communicated regularly via email and updated resources via Dropbox. The authors developed the research survey questionnaire, collected data, analyzed the data, and wrote a research paper for a conference based on a qualitative analysis of student expectations data. They also began work on journal articles.
<i>Observe</i>	Made observations on the practice and evaluated its effects. The authors, who are also researchers and instructors, adopted an evaluation and self-assessment strategy. This included regular updating of resources via Dropbox, weekly discussions via Skype and email to address issues arising from classroom observations, close monitoring of students' performance, answering their questions, conducting on-going student feedback sessions and briefings. During this phase, most of the exchange was based on what was working, and what not working with their respective students. A great degree of coordination was required by the instructors, so that they could ensure a good overall experience and learning for their students. The advantage was that, by this time, the authors had developed a good rapport and an understanding, which made the process easier.
<i>Reflect</i>	Reflected upon the results of the evaluation, modifying actual practice for next revised implementation of the next cycle of the collaborative student feedback. Despite the complex nature of the collaborative activity, students provided positive feedback about their experience including learning from one another's culture and being motivated to collaborate in the future. This positive feedback from students affected the judgment of the authors regarding the success of their own collaboration as well. The huge amount of data gathered required additional time to be factored in. The work in the collaborative project had to be balanced with the other individual activities and responsibilities of the coauthors. Based on the observations and reflections, the researchers would modify the actual practice of conducting the next round of collaborative feedback research project in Cycle 2.

<i>Cycle 2</i>	The same cycle of Plan, Act, Observe and Reflect was repeated in Cycle 2 during the next run of the subjects in Oct 2013, when a new set of collaboration was conducted between new batches of students of the two schools. This time, the authors decided to make the student collaboration synchronous – where the US students taking a different course presented their research to their Singapore counterparts on Skype, and later provided feedback asynchronously on the virtual recorded presentations by the US students. Thus, the success of one round of collaboration triggered further collaboration, and is likely to continue.
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**Table 4. The process followed in each phase of the Action Research Framework**

Anderson and Herr (1999) developed 5 criteria to ensure that action research has been done rigorously and effectively:

1. *Outcome validity* – the extent to which actions occur which lead to a resolution of the problem that leads to the study. The authors came together to find ways to get their students to collaborate with each other. This was successful, as evidenced by a sample of two students’ reflections/expectations: “This collaboration opened my eyes to what other students elsewhere had chances to. It showed me their capabilities and their imaginative power, her web page was undoubtedly well done, in my opinion”. – a Singapore student. Another Singapore student wrote, “Before I started on this USA collaboration, I honestly did not know what to expect. I’ve never communicated with people overseas, so I was actually quite fearful but also excited upon this USA collaboration. I was afraid I would not be able to communicate well with our USA counterparts. But in the end, when I did the peer collaboration review on their website, I felt that it wasn’t actually that tough to get through to them. They showed serious effort in their work and that made me want to work just as hard as well! Overall I find that this collaboration is going on smoothly and so far so good!”

2. *Process validity* – the extent to which problems are framed and solved in a manner that permits ongoing learning of the individual or system. The findings of the study were a result of a series of reflective cycles that included reevaluating the problem and the research questions at various stages as the researches finalized the area of study, and the details of the assignment and collaboration instructions to be given out to students. The assignments sheets and criteria developed for the student evaluation, as well as the documents created in the shared Dropbox folder, and the series of emails exchanged, all formed the evidence to support the validity of the process.

3. *Democratic validity* – the extent to which research is done in collaboration with all parties who have a stake in the problem under investigation. As the authors designed the study and the nature of their collaboration, issues of ethics and social justice were paramount on their minds. The study was approved by the institutional review board/ethics committees of both institutions. Informed consent forms were designed and approved that required seeking consent from students to use their data for research and publication purposes. Even though the collaboration itself was a graded part of the course, students were free to

allow the use of their data or not. Also, the collaboration designed was aimed at helping the students learn about a different culture and discipline.

4. *Catalytic validity* – the extent to which the research process reorients, focuses and energizes participants toward knowing reality in order to transform it. The Singapore students were insecure about their language proficiencies, while the US students feared that they may not be as technology-savvy as their Singapore counterparts. The students confirmed through the reflections that the collaboration helped break stereotypes they had about their prospective collaborators, as well as about themselves. The authors of the study themselves grew in the process of this collaboration. The primary learning was three-fold: 1) the collaboration confirmed for them that it was possible to do class-room research successfully and ethically; 2) that collaboration enriches the experience for themselves and their students; 3) that collaboration was an important determinant of research productivity.

5. *Dialogic validity* – to ensure that the research has passed through the process of peer review. This research passed through multiple rounds of review. It was part of and evaluated by the Center for Excellence in Teaching at Simmons University (then College), anonymous reviewers, and a research assistant. Thus, it underwent multiple rounds of reviews and revisions and was strengthened in the process.

### Findings and discussion

Using the Action Research Framework provided an important lens to make sense of the entire collaboration process.

The first stage of planning was perhaps the most important to ensure that the collaboration was successful. The main focus of the action planning stage was deciding to collaborate and narrowing down towards the focus of collaboration. These are the set of key findings from the planning stage: 1) A person looking for possible collaboration needs to be proactive; 2) Requests for collaboration need to be timed well; 3) Shared context and shared interests help bring collaborators together; 4) Silence does not mean loss of interest. It might mean a lack of clarity on details or how to proceed, or that the possible collaborator is busy. Follow up after a few days if you do not hear back; 5) A face-to-face meeting or some form of synchronous interaction (either on phone, Skype or other software) is necessary to work out complex details; 6) When setting up

virtual meetings, be mindful of availability and time difference; 7) Schedule 1 hour or more for the first face-to-face or online synchronous meeting.

The second phase in the action research framework suggested by Riding, Fowell, and Levy (1995) is that of implementation or acting upon the planning done. Summarized below are the key lessons learned in the first two phases and the specific phases they apply to:

1. *The role of motivation* (plan, act): The motivation was extremely important to make this collaboration a success. Both the collaborators were motivated to proceed with this collaboration because of the possibility of publishing the results of the research study findings in an external journal publication and presenting at a conference. This would contribute directly towards the professional development of both researchers who are also collaborators and lecturers of the subjects being studied. Publishing was important for tenure and promotion considerations of both researchers, thus providing a strong motivation to collaborate.

2. *Initial expectations in terms of pedagogy and learning outcomes* (Bowl, Cooke, & Hockings, 2008) (plan): At the professional level, the authors expected to share with other fellow educators, their knowledge, experience and practice of incorporating blended e-learning approaches into their courses. In terms of student development, the authors' expectations included providing students with a more flexible, stimulating and independent learning environment to increase the level of interactivity in teaching and to enhance student learning; teaching students practical and real-life skills of providing effective and constructive feedback/comments on each other's work; and teaching students to appreciate learning, networking and communicating with other students across different cultures, countries and even age groups. The level of student engagement (asynchronous, limited to student feedback on assignments) was customized to suit the students' different educational, cultural backgrounds and geographical locations (Bowl, Cooke, & Hockings, 2008).

3. *Initial views of research questions / goals of the action research* (plan): The questionnaire for the students was very detailed and attempted to seek answers to achieve goals for the research. It was necessary to invest time and effort to craft good research questions to facilitate data analysis. This will, in turn, translate into meaningful research outcomes and contribute to current literature on the topic. It is also important for researchers to use survey questions that have been tested in past studies and to self-develop when questions are not found for certain constructs and variables.

4. *Careful planning* (plan): The researchers learned that good planning and careful time management was necessary to match the timing of the Singapore school's

start of the October 2012 semester with the September start of the Fall semester in the US school. The collaboration was successful mainly because the researchers had designed a detailed research project brief and assignment instructions that provided clear guidance before, during and after the research project process. The process of action research also helped in this endeavor.

5. *Overcoming time constraints* (plan, act): The collaborators invested a lot of time and effort into the collaborative project. This becomes necessary in order to carefully carry out the stages of the research i.e. planning, action, observation and reflection leading to further cycles of research and development. Despite facing the challenges to complete the collaboration within the time constraints of the semester deadlines, the collaborators managed to overcome this by implementing effective time management techniques including advanced planning to ensure the success of the collaboration.

The *plan* and *act* stages of the action research framework were followed by evaluation ('*observe*' in Figure 1) and reflection ('*reflect*' or '*learn from evaluation*' in Figure 1) (Riding, Fowell, & Levy, 1995). Summarized below are the key lessons from these other phases:

1. *Synchronous interaction / Use of appropriate technology tools* (Dawson, 2012) (act, observe): The collaborators learned that good use of technology for asynchronous interaction, memory and future recall (email), synchronous interaction and building of a shared context (face-to-face meeting or Skype) and cloud-based, seam-less document sharing (Dropbox) helps to facilitate effective communication. The use of these tools provided a conducive environment for the authors to discuss and solve pertaining issues and challenges faced. The collaborators also learned about the importance of using the appropriate technology to support interaction between students. The Facebook discussion was chosen as it is user-friendly and widely used amongst students in both the US and Singapore even though they are from different cultures and age groups (Dawson, 2012).

2. *Managing student expectations and experiences* (plan, act, observe): The collaborator from the US had to manage the expectations of much older Masters-level students (58 students in 2 sections) sharing their web portfolios and interacting with teenage students from another culture and country. The collaborator from Singapore was faced with the challenge to manage and coordinate collaboration involving 238 students in 10 classes from various course disciplines across different schools in the Singapore institution. Coordination was also required with a co-tutor who handled 3 of the 10 classes. This challenge was overcome by following these steps: i) dividing students in each of the 10 classes into smaller groups of 4-5 students and assigning each group with a research topic (1 or 2 US

students were assigned to each group); ii) assigning a group leader for each research group to help coordinate work that needed to be done at the group level; iii) briefing at the start of the research project; close monitoring, observation, and feedback during the process and debriefing, feedback and affirmation at the end of the process (this was done for the US students as well); iv) using a learning management system and social media (Twitter and Facebook) to communicate with students and address their concerns and queries (the US students used a separate learning management system, though the interaction with Singapore students was on Facebook); v) using face-to-face discussions and briefing sessions to address student expectations and to address their concerns (done for both Singapore and US students).

3. *Ensuring rigor / time-consuming steps* (act, observe, reflect): The collaborators reflected on the amount of time that each step took – from figuring out what to collaborate on, to finalizing the research questions, coming up with a research model and hypotheses, deciding on what data to gather (both quantitative and qualitative), doing a thorough literature review and coming up with survey questions, finalizing dates for collaboration and instructions for students, preparing IRB documents, analyzing the data gathered and working on research articles for conferences and journals – and this, apart from everything else that each collaborator might be doing during that period. Both authors are satisfied that they were able to ensure research rigor during the entire process. Despite the time spent in each step, the collaborators have benefited in terms of professional and personal growth and development, as well as incorporating the research into their teaching.

Thus, this study identified the following pre-conditions for successful collaboration – the timing of collaboration, a shared interest in the collaboration, and a high degree of motivation in the study. This is in line with the “commitment to mutual relationships and goals” identified by Mattessich, Murray-Close, & Monsey (2001, p.4) and the interactional determinants (willingness to collaborate, trust, communication, and mutual respect) identified by Martin-Rodriguez, Beaulieu, D'Amour, & Ferrada-Videla (2005). The organizational determinants (Martin-Rodriguez et al., 2005) of both the co-authors were also supportive of collaboration, and one was the tenure and promotion process did not view collaboration negatively. Finally, the systemic determinants (Martin-Rodriguez et al., 2005) of the socio-cultural, professional and educational systems of the two co-authors were also supportive of collaboration. The first author, while based in the United States, had spent many years in Singapore. This helped provide a common grounding of the socio-cultural understanding of Singapore and its students and the educational environment, which helped in the collaboration. This was in line with the homophily factor identified by Dahlander & McFarland

(2013), who found that people tend to select collaborations with others similar to themselves.

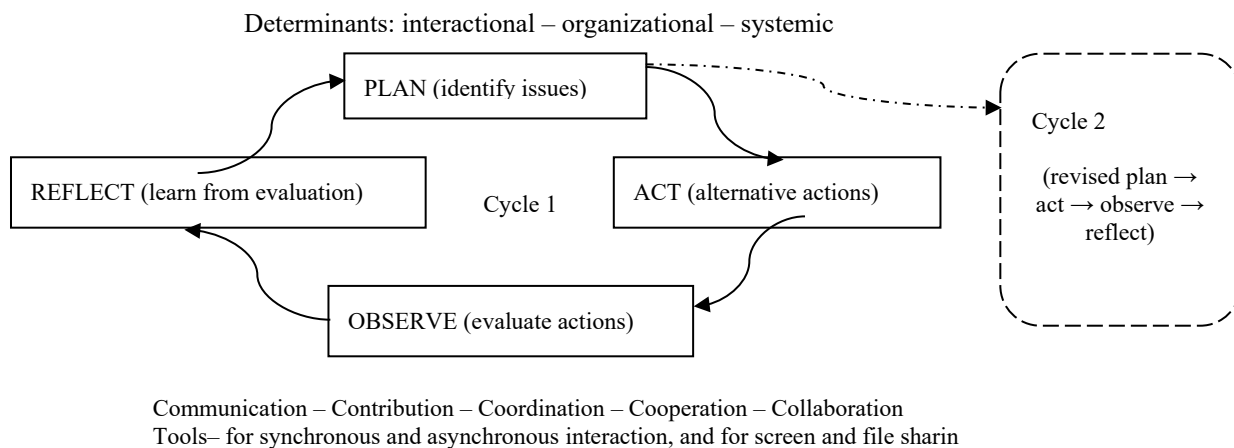
The collaboration involved all the 5 Cs identified by Taylor-Powell, Rossing, & Geran (1998) and Shah (2012). Communication was facilitated by email and Skype calls. The contribution was mutual and led to deliverables in the shared Dropbox folder. Coordination was necessary to liaise with the respective students and to ensure common timings for the two sets of students to collaborate. Cooperation and collaboration were at the heart of all work carried out in the study.

In carrying out the collaboration, a few factors were salient. These included developing a shared context, setting up synchro-nous calls, noting time differences and overcoming time constraints. The planning stage of the study corresponded to Gray (1989)'s problem-setting and direction-setting phases. The act and reflect stages of the study corresponded to Gray (1989)'s implementation phase of collaboration.

Figure 3 below shows the framework for action research for instructor collaboration. It combines the action research framework (adapted from Riding, Fowell, & Levy, 1995; Yasmeen, 2002) with the determinants for successful collaboration (interactional, organizational and systemic – identified by Martin-Rodriguez, Beaulieu, D'Amour, & Ferrada-Videla, 2005), the 5 Cs model (Taylor-Powell, Rossing, & Geran, 1998; Shah, 2012) and the technology tools necessary for successful collaboration. The framework should help other instructor-researchers seeking to initiate and carry out collaborations with each other.

### **Conclusions and implications**

In this paper, we have mapped the findings based on our collaboration with the action research framework adapted from Riding, Fowell, and Levy (1995) and Yasmeen (2002), as well as other collaborative frameworks. The findings have included the triumphs and challenges, technologies to be used, type and frequency of collaboration that led to a successful outcome for collaborators and effective learning and satisfaction for students. Good use of relevant tools and technology helped in motivating and supporting both the students and the authors to ensure successful collaboration. The main contribution is the action research framework for instructor collaboration. The findings and the framework should be useful both for instructors seeking to collaborate for research and to facilitate collaboration between their students, as well as practitioners of action research. The paper should also help further research on collaboration and collaborative information behavior.



**Figure 3. Action research framework for instructor collaboration**

The study has a few limitations: First, it is limited by a specific task – initiating collaboration between respective sets of students. Different tasks might call for different collaborative experiences. Second, the collaboration was specific to instructors based in two countries. The unique contexts of these countries affected the collaboration and its outcomes. Different countries would require different levels of cultural and organizational sensitivities about collaboration. Finally, the personalities and the prior experiences of the co-authors made the collaboration unique. Different people with different personalities and experiences might take to collaboration differently. These factors limit the generalizability of the findings. Future work will involve reporting on the student collaboration and the outcomes of subsequent cycles of collaboration.

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# A Bibliometric analysis of social media research in finance

**Baoqiang Zhan**

Guangdong University of  
Technology, China  
2111708031@mail2.gdut.edu.cn

**Helen Du**

Guangdong University of  
Technology, China  
hsdu@gdut.edu.cn

**Jiahong Xu**

Guangdong University of  
Technology, China  
xujiahong@mail2.gdut.edu.cn

## ABSTRACT

In this paper we provide a review on social media research in financial domain using bibliometric analysis. Nowadays social media is gradually influencing different aspects in our lives, especially for finance. However, there seems to be very limited understanding of social media use in finance. This paper intends to provide some clarification with respect to existing literature. First of all, the developmental features are extracted regarding statistical and bibliographic performance of the literature. Then, the evolutionary process of social media in finance are summarized and divided into infancy period, booming period and transition period. Finally, social media's utility in finance is categorized as five orientations: financial service, financial improvement, financial investment, financial innovation and financial security. Time series perspective and cross section perspective are combined in this analysis to provide a better insight into social media research in finance.

## Keywords

social media, finance, bibliometric analysis, review

## Introduction

Social media is gradually enhancing its influence in the recent decade as it has been used in a variety of contexts in our daily life, such as education, politics, business, management and so on. As an essential part in our society, finance has a highly relationship with social media as well. How can social media involve in finance? What's the relationship between them? Generally, existing literatures mainly focus on three perspectives regarding social media's use in finance: personal finance, corporate finance and public finance. However, the relationship between social media and finance remains unclear. As for the concept of social media in finance, Alexander and Gentry (2014) regarded social media as a recognized channel of providing fair disclosures of corporate financial information to investors, which is also not that comprehensive. Therefore, it's necessary to provide a clearer illustration of the mechanism of social media's use and impact on finance, and find out the exact relationship between them.

In this paper we use bibliometric analysis as our research method, providing a comprehensive overview of the current research landscape. Three contributions that we make to the literatures are as follows. (1) We extract the developmental features and evaluate both the statistical and bibliographic performance of the research of social media in finance. (2) We present the evolutionary process of the research during 2007-2017, and divide it into three developmental periods. (3) We provide a classification of the current research and illuminate the future orientations of social media research in finance.

## Research framework

The research framework is adopted from Hong, Chan et al. (2012) and Du, Ke et al. (2017), which com-poses of three stages: retrieval, filtering and validation.

### Stage 1

In stage 1, we first retrieve papers related to our topic from Web of Science (WOS) platform. The retrieve entry shown below also contains two subjects (social media & finance), in which we consider as much related terms as possible. As a consequence, 1316 papers are collected and constitute a research dataset.

*TS = ("Web 2.0" OR "User Generated Content" OR "social media" OR "digital media" OR "social platform\*" OR Twitter OR Facebook OR Weibo OR Instagram OR LinkedIn OR blog\*) AND TS = (fi-nanc\* OR loan\* OR lend\* OR deposit\* credit\* OR debt\* OR "stock\* market\*" OR "future\* market\*" OR "option\* market\*" OR "bond\* market\*" OR "fund\* market\*" OR P2P OR "business performanc\*" OR shareholder\* OR accounting\* OR audit\* OR budget\* OR asset\* OR cash\* OR bank\* OR revenu\* OR expenditure\* OR tax\* OR incom\* OR insuranc\*)*

### Stage 2

Stage 2 is the process of filtering, during which visual examination is conducted to check for each paper in the dataset. Some criteria are set to exclude the unrelated papers, which comprise but not limit to three subjects of social media use in finance: personal finance, corporate finance and public finance. To ensure the rigor of the selection, we

invite a tester to review the dataset and select the relevant papers using the criteria. Finally, 776 relevant papers are selected.

### Stage 3

In stage 3, we randomly select 20% of the 1316 articles in the dataset, from which another tester is invited to select the relevant articles, too. By comparing the results between two testers, we calculate the agreement rate, which is highly up to 94.3%. It indicates that the retrieve entry expresses our topic exactly, as the selection results of the two testers stay in high consistent with each other. Therefore, we finally determine 776 articles as our research objects for further analysis.

### Statistical performance

Using bibliometrics analysis, the literature can be reviewed from two perspectives: statistical and biblio-graphic perspective. In this part, we first display the statistical performance of the dataset, and excavate the developmental features of the research.

#### Distribution of publications and citations

The number of publications and citations reflects the popularity of a research topic. We first analyze the distribution of publications and citations by year and country. As for yearly growth, both publications and citations of the research have gradually increased over years as expected. This implies that the topic of social media in finance raise a growing interest and popularity, which attracts more and more re-searchers' attentions.

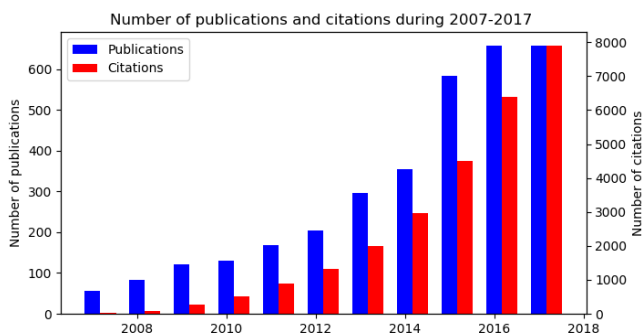


Figure 1. Number of Publications and citations

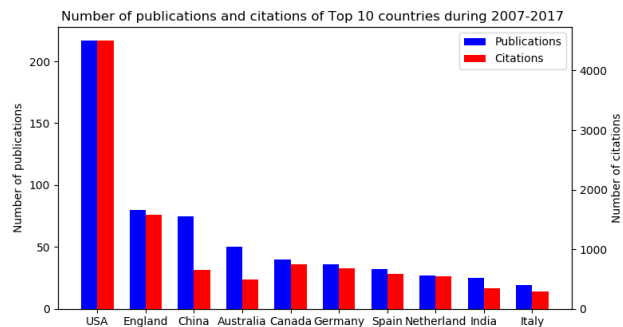


Figure 2. Publications and citations of Top 10 countries

Regarding the distribution of publications and citations by country, USA has published 217 papers and received citations for more than 4500 times in the research of social media in finance during the latest decade, being the most productive as well as the most-cited country. After USA are England, China, Australia and Canada successively in productivity. However, the publishing number of China is nearly the same as that of England while the cited number is far lag behind. So is to Australia.

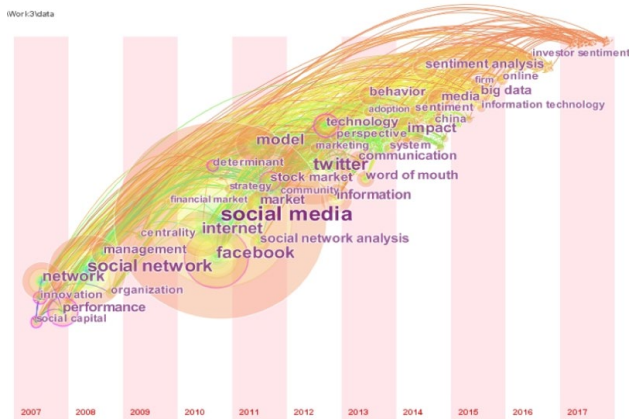
### Bibliographic performance

In this part, keywords co-occurrence analysis and references co-citation analysis are conducted to present the bibliographic performance of the research, which further dig out the evolutionary process and future orientations of our topic.

#### Co-occurrence analysis of keywords

First, we conduct co-occurrence analysis of keywords using CiteSpace, an application enabled to detect emerging trends and transient patterns in scientific literatures of certain research domain. According to the analysis results (see Figure 3), we basically divide the evolutionary process during 2007-2017 into three periods.

**(1) Infancy period (2007-2009).** The main keywords in this period focus on corporation business and management, such as “social capital”, “performance”, “organization”, etc. Before 2010, social media was still in its infancy. Interpersonal communication was far more common than in virtual platforms when networking. Therefore, the interaction of social media and finance was not so frequent and the research of this domain is mainly focus on corporation business and management.



**Figure 3. Co-occurrence analysis of keywords**

**(2) Booming period (2010-2014).** Social media faced its booming in financial domain during 2010-2014. In particular, social media’s cross into financial market made it become not only a tool for communication, but also a platform for different kinds of financial activities. Some keywords like “finance”, “stock market” and “investment” were the cores in this period. Explicitly, the research area could be categorized in three levels. First is public level, concerning about how the macro-finance market change over information spread through social media. Second is corporate level, which concentrates on social media’s effect on corporate performance. The last is microscopic level that focuses on consumers’ behaviours and investors’ decision making.

**(3) Transition period (2015-2017).** Social media has stepped into transition period since 2015. Some keywords like “sentiment analysis”, “big data” and “information technology” are conspicuous. In this period, more and more researchers study text mining and sentiment analysis to test the market reaction over social media information and try to predict the market prices. Generally, social media’s interaction with finance in different periods show the evolutionary process of the research, the change of research methods and researcher’s emphasis are also included.

**Co-citation analysis of references**

Cluster analysis aims at classifying elements into categories on the basis of their similarity, which helps to conclude main research orientations of certain research field. We apply cluster analysis to reference of the dataset in cross-section level, trying to untangle the current research’s focus, progress and future orientations. Here, five orientations are clustered as follows.

**(1) Financial service.** This category covers a variety of social media applications in financial services, e.g. P2P lending, mobile payment, crowdfunding and group-buying etc. (Chompis, Bons et al. 2014). Undoubtedly, social media integrates itself deeper and deeper into our lives as its diversity and inclusiveness. Moreover, social media makes

it easier for the mess of people to better manage personal finance or household finance. Most research in this category focus on how social media applications bring about the changes in people’s way to manage their finance.

**(2) Financial improvement.** Social media in financial improvements mainly stand on the basis of corporation performance. Evidences show that social media affects directly on corporation financial performance and provides financial improvements in many aspects, such as firm equity value, stock returns and sales (Dhar and Ghose 2010). Social media is regarded as a platform for financial disclosure and financial report (Alexander and Gentry 2014), which not only increases business transparency, but also enhances customers’ loyalty and engagement. In addition, it’s also used as a tool for financial evaluation, specifically in auditing and accounting (Arnaboldi, Busco et al. 2017). Through the evaluation, a corporation can better understand the operation situation and devise counter-measures consequently to pursue financial improvements.

**(3) Financial investment.** Social media plays an important role in financial investment as it offers a convenient channel to invest for individual and corporation. Firstly, as a source of news and messages, social media attracts a lot of people to search and share useful investment information (Leinweber and Sisk 2011). Secondly, social media improves people’s decision making and participant in investments (Gu, Konana et al. 2014). Moreover, social media helps to maintain the relationship between investors and corporations (Dootson, Beatson et al. 2016). Therefore, social media could not be neglected in to-day’s financial investment as it directly links to the return of investment.

**(4) Financial innovation.** Social media in financial innovation involves many aspects. For instance, (1) Sentiment analysis: a large amount of research extracts the text features of social media information to detect the investors’ sentiments (Danbolt, Siganos et al. 2015) and to predict the stock prices or firm value (Bollen, Mao et al. 2011). (2) Financial reform: financial institutions deploy social media to reform a new financial framework and organization (Balnaves 2012). (3) Big data analytics: novel trading strategies using big data analytics through all types of social media information have been gradually developed and popular in today’s financial market (Tambe 2014). Social media facilitates reformation and innovation of financial market, which to some extent promote development of finance in individual, corporation and even government.

**(5) Financial security.** Financial security has become an increasingly important issue in our daily life. Social media is like a double-edged sword for financial security. On one hand, as a source of information, social media spreads rumours and fake news sometimes (Brigida and Pratt 2017), which may lead to un-expected results of financial

investment. More severely, the fake news violates the privacy and exposes the financial information, thus causing the great loss to individuals and corporations. On the other hand, social media data can be used to predict the default rate and thus detecting the financial fraud (Lundstrom 2013, Li, Chen et al. 2016). Therefore, more attention should be paid to financial security when we are using social media.

## Conclusion

In this study, we first present the statistical performance of current research to identify the developmental features in publications and citations. Then bibliographic performance is also evaluated using keywords co-occurrence analysis and references co-citation analysis, which simultaneously explores the evolutionary process and future orientations from time series perspective and cross section perspective. As a consequence, a three-period (infancy period, booming period and transition period) characteristic is captured and five major orientations (financial service, financial improvement, financial investment, financial innovation, and financial security) are drawn. The findings of this study reveal the mapping and provide insights of the research on social media in finance, which raises awareness of the benefits of social media research in finance for both researchers and practitioners. Moreover, the analysis offers valuable information for conducting further studies.

## Implication

This study provides both theoretical and practical implications. First, most research that we reviewed about social media's use in financial investment depicts investors' psychological and behavioral characteristics, which enrich the theory of behavioral finance. Second, the research orientation concerning social media's impact on financial security needs further study. There exists a research gap between information security and social finance. This research orientation should raise more researchers' attention since it covers the least number of papers compared to other research orientations. Finally, the closer and closer relationship implicates the opportunities of deeper integrations and wider applications of social media in finance. It's important for companies to grease the wheel of the development of social finance and bring more convenience to our daily life.

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# Can Gamification Bring Long-term Effects for Elementary Students' Learning?

**Jiawen Zhu**

University of Florida  
Gainesville, United States  
Jiawen.zhu@ufl.edu

**Xiuhan Li**

The University of Hong Kong  
Hong Kong  
u3003557@hku.hk

**Yin Zhang**

Department of Education,  
Ocean University of China,  
Qingdao, P. R. China  
zhangyinouc@sina.com

**Zamzami Zainuddin**

The University of Hong Kong  
Hong Kong  
zamzamizain@hku.hk

**Shum Yi Cameron Lee**

The University of Hong Kong  
Hong Kong  
sycamlee@hku.hk

**Samuel K.W. Chu**

The University of Hong Kong  
Hong Kong  
samchu@hku.hk

**Xiao Hu**

The University of Hong Kong  
Hong Kong  
xiaoxhu@hku.hk

## ABSTRACT

Gamification is known to facilitate learner's engagement and motivation. However, whether gamification has positive long-term effects on students' learning habits and interests remains an under-explored topic in education. This study, in examining learners' performance on a gamified e-learning system, aims to analyse the long-term effects of gamification on primary school students' reading literacy. Twenty-nine elementary school students in Hong Kong, 14 of whom were female, and 15 others were male, participated in this longitudinal mixed-method study, which includes questionnaires and semi-structured interviews sampled three times across a period of 6 months. Findings reveal that gamified pedagogies did have durable positive impacts on children's reading literacy, particularly on their reading interests, habits, abilities and emotional states. This study suggests that gamified learning tools can facilitate reading literacy development in children over a longitudinal scale, and the results of this study provide insights for future researchers and educators.

## Keywords

Gamification, Reading literacy, Gamified e-learning system, Motivation

## ASIS&T Thesaurus

E-learning, Educational technology, Elementary schools

## Introduction

Gamification in learning is an emerging trend of research. Deterding and others (2011) define gamification as "the use of game design elements in non-game contexts" (p.9). Numerous works of gamification research in different education domains point to various degrees of positive impacts on overall learners' experience, such as increasing motivation and engagement (Mekler et al., 2013), improving performance (Liu et al., 2017) and fostering social connection [Alomar et al., 2016]. From these studies, a consensus seems to form around the notion that gamification can engage learners deeply in learning activities.

Behind learners' engagement to a task, one cannot begin to see a full picture of it without studying motivation. To understand learners' motivation better, a well-known theory in the field called the Self-Determination Theory (SDT), conceived by Ryan and Deci in 1980, may provide a fuller picture on how learners learn and engage themselves in a task (Deci, 1971). According to SDT, learner's motivation is driven extrinsically by their "performance [to] an activity in order to attain some separable outcomes (i.e. contingent rewards in most cases)" (Ryan & Deci, 2000, p.71). This contrasts with intrinsic motivation, another side of motivation driven by innate psychological needs. According to Ryan and Deci, intrinsic specifically refers to "doing an activity for the inherent satisfaction of the activity itself", suggesting personal desires at work in finishing a task (Deci, Koestner, & Ryan, 2001). Relating SDT to gamification study, scholars have tried in designing a learning platform in which learners are stimulated to learn out of personal desires than extrinsic rewards.

Although many studies indicate that gamification provides a bevy of positive effects on learners with the most prominent one being increased learning engagement and motivation (Tsay, Kofinas, & Luo, 2018), only a handful would study their samples on a longitudinal scale. Pertaining to the domain of learners' attrition, many scholars criticize that the post-test effects of gamification, characterized by ranking and rewards, only encourage extrinsic motivation and discourage intrinsic motivation, a zero-sum game in essence (Hanus & Fox, 2015). They argue that without elements of gamification (e.g., scores, rankings, and rewards), learners will regress to the starting point of their learning, thereby not only is the value of their research participation diminished, the potential effects of gamification are also trivialized (Deci et al., 2001). Research shows although scholars hope gamification facilitates learning with longstanding positive effects, there is inadequate evidence to support the long-term benefits of gamification (Dichev & Dicheva, 2017).

Against that backdrop, this study seeks to understand, evaluate and critique/mitigate that divergence of perspectives through a gamified e-learning system (GES). By studying how students used the platform to learn English, this study hopes to delineate any possible links between gamification and learner's motivation and engagement. At the end of the day, when those links are made clear, gamification can point to new learning alternatives for students who learn English as a second or foreign language.

## Methods

The GES employed in this study provided gamified e-quiz for primary students when they finished reading a book. To test this system, the current study asks: What are the long-term effects of using the GES? In answering that question, four sub-questions are devised: What are the implications of the GES on students' reading interests? What are the implications of the GES on students' reading habits? What are the implications of the GES on students' reading abilities? What are the implications of the GES on students' reading motivation?

## Sampling

The GES contains questions derived from over 500 children's storybooks. Aimed to strengthen the reading comprehension abilities of Hong Kong primary school students, the platform administers mid- and post-reading tests for them (Chu et al., 2015). This GES contains gamified elements, like badges, scores, rankings, etc. Since its inception, it has been used in more than fifty primary schools and libraries in Hong Kong, Taiwan, the U.S., and Mainland China (Chu et al., 2015). To explore the long-term educational effects of the GES on children, we randomly sampled active users who used the GES extensively (i.e. over 100 storybooks read) and who stopped using it for more than six months. These filters could help point to a

longitudinal pattern of learners' skills and performances previously concealed from educational game developers and researchers. Based on these, twenty-nine participants, comprising 14 female students and 15 male students from four primary schools in Hong Kong, were scrutinized for further study.

## Data Collection and Analysis

A mix-method approach was used when collecting data (Creswell & Clark, 2017). Semi-structured interviews with follow-up questionnaires were administered. Modelling on the Intrinsic Motivation Inventory (McAuley et al., 1989), the questionnaires for the assessment of the GES were further adapted based on PIRLS 2011 Analytical Framework (Mullis et al., 2009) and Wang and Guthrie's study (2004). Quantitative data from the questionnaires were assessed on a six-point Likert scale, designed around three time periods (i.e. before, during and after using the GES). All data collected during the interviews and from the questionnaires came only after students stopped using the GES for more than six months. Participants' feedbacks were analyzed separately based on PIRLS 2011: one in which quantitative data collected through the questionnaires were evaluated by non-parametric Friedman Test followed by pair-wise post-hoc comparisons across the three time periods, and the other in which qualitative data from interviews were transcribed and translated into both Chinese and English.

## Results and Discussion

### *SQ1: Implications of the GES on Students' Reading Interests*

Participants reported that their reading interests were stimulated when using the GES, and remained high after they stopped using the GES, compared to prior using the GES (see Table 1). There were statistically significant differences in reading enjoyment ( $p < .001$ ) and reading importance ( $p < .001$ ) across three periods. Post hoc analysis with Wilcoxon signed-rank tests was conducted with a Bonferroni correction applied with a significance level set up at  $p < 0.017$ . The results showed that reading enjoyment during using the GES was significantly higher than before using the GES and enjoyment after using the GES kept higher than before. However, there were no significant differences between during and after using the GES.

Similar findings were found about thinking reading important aspect. Participants thought reading more important during using the GES than before and kept this status after using the GES. Several participants mentioned that prior to using the GES, they thought reading was only for time-killing and that they hated to read. A participant [WH-CLC] stated during the interview. "I found the GES helpful for me to complete my homework as it provides a wide range of book choices. For now [i.e. after he stopped using], I think books can help me find the answer most of the

time, so I still think it is important to read even though I don't use the GES anymore". Most of the participants had similar feelings towards the GES in the sense that after they used the e-learning platform, they began to realize that reading is interesting and that their love for reading has only just blossomed. This affirms the notion that the e-learning platform can heighten reading interests over a sustained period.

	Before	During	After	<i>p</i>
Reading Enjoyment	3.26 (1.09)	5.12 (0.75)	4.86 (0.92)	.000
Thinking Reading Important	3.45 (1.21)	5.03 (0.87)	5.07 (0.88)	.000

**Table 1. Means, Standard Deviations (in parentheses) and Friedman Test *p*-value of Reading Interests in Three Periods**

### ***SQ2: Implications of the GES on Students' Reading Habits***

Regarding reading habits, it can be inferred from quantitative data that participants had increased their reading frequency and expanded on the breadth of their reading choices, while they were using the GES. These habits extended further than the GES (see Table 2). There were statistically significant differences in reading frequency ( $p < .001$ ) and the breadth of reading ( $p < .001$ ) across three periods. The results showed that reading frequency during using the GES was significantly higher than before using the GES ( $Z = -4.643$ ,  $p < .001$ ), frequency after using the GES kept higher ( $Z = -3.974$ ,  $p < .001$ ). Additionally, participants read broader during using the GES than before ( $Z = -4.753$ ,  $p < .001$ ) and kept this habit after using the GES ( $Z = -4.254$ ,  $p < .001$ ). Interview data were consistent with quantitative findings on this aspect. The GES had stimulated participants to read more and explore different genres of books. Twelve participants in this study admitted that they had only read one type of books they liked before using the GES and that their choice widened immediately after using the GES. Responses from the interviews confirm earlier findings in questionnaires in that the reading habits formed during the GES endure well after respondents stopped using the platform. This provides evidence against the perception that once extrinsic elements like competition and reward are taken away, learners revert to their pre-test selves.

	Before	During	After	<i>p</i>
Reading Frequency	3.95 (1.07)	5.48 (0.63)	4.83 (1.14)	.000
Breadth of Reading	2.62 (1.05)	4.79 (0.86)	4.28 (1.13)	.000

**Table 2. Means, Standard Deviations (in parentheses) and Friedman Test *p*-value of Reading Habits in Three Periods**

### ***SQ3: Implications of the GES on Students' Reading Abilities***

Other than reading habits, quantitative data also shows that participants' reading abilities improved and endured after stopping using the GES. Although all participants stopped using the GES for at least six months, their perceived reading ability was reportedly higher ( $M = 4.76$ ,  $SD = 0.82$ ) than before ( $M = 3.26$ ,  $SD = 0.85$ ) and during ( $M = 4.69$ ,  $SD = 0.75$ ) they used the GES. There was a statistically significant difference in this self-reported reading ability ( $p < .001$ ). The perceived reading ability was higher during using the GES than before and remains higher after using the GES. In the interviews, multiple participants [SPMLT-CKL, SPS-LZD] mentioned that their test scores in Chinese and/or English reading and writing improved after using the GES, and their reading comprehension ability also enhanced in other subjects. This association of the GES usage and performance improvement in language learning suggests that reading skills picked up through an e-learning channel can be cross-applied to formal educational contexts.

	Before	During	After	<i>p</i>
Enjoyment	3.60 (1.05)	5.10 (0.77)	4.98 (0.85)	.000
Usefulness	3.22 (1.10)	4.93 (0.96)	5.02 (0.99)	.000
Competence	3.29 (0.84)	4.95 (0.83)	5.02 (0.78)	.000
Curiosity	3.28 (1.00)	4.64 (0.88)	4.38 (0.78)	.000
Challenge	2.83 (0.89)	4.98 (0.89)	4.57 (1.00)	.000

**Table 3. Means, Standard Deviations (in parentheses) and Friedman Test *p*-value of Positive Feelings in Three Periods**

### ***SQ4: Implications of the GES on Students' Reading Motivation***

Finally, participants' reading motivation has been tracked throughout their use of the GES. As the data shows, participants derived feelings of enjoyment, usefulness, competence, curiosity, and challenge from playing the GES (see Table 3) and reduced negative feelings like academic pressure and boredom arising from reading (see Table 4). The results showed that feelings of enjoyment during using the GES were significantly higher than before using the GES and enjoyment after using the GES kept higher than before. However, there were no significant differences between during and after using the GES. Usefulness during using the GES was higher than before and kept higher after using the GES, while there was no significant difference between during and after. Competence during using the GES was

higher than before and kept higher after using the GES, but there was no significant difference between during and after. Curiosity during using the GES was higher than before using the GES and kept higher after using the GES.

Feelings of challenges during using the GES was significantly higher than before using the GES and kept higher after using the GES. Considering negative feelings, there were statistically significant differences in pressure ( $p=.027$ ) and boredom ( $p<.001$ ) across three periods. The results showed that feelings of boredom during using the GES was lower than before using the GES and kept lower after using the GES. However, there was no significant difference in boredom between during and after using the GES. Additionally, there were no significant differences in pressure between during and before, after vs. before, and during vs. after. When asked if playing this platform brought about any negative feelings, the majority of participants replied with a 'no'. Some participants (e.g., [SPS-LZD]) mentioned that the reason they played the GES was mainly because of the sense of satisfaction they could get out of topping the users' ranking and getting rewards. As time went on through post-usage, they developed a yearning for books. This confirms earlier speculations that the GES motivates students to continue reading in post-usage settings.

	Before	During	After	p
Pressure	1.67 (0.91)	1.52 (0.91)	1.36 (0.85)	.027
Boredom	1.91 (1.18)	1.21 (0.43)	1.24 (0.64)	.000

**Table 4. Means, Standard Deviations (in parentheses) and Friedman Test p-value of Negative Feelings Differences in Three Periods**

### Conclusion and future work

For years, people have doubted over whether gamification can facilitate intrinsic motivation and deliver long-term benefits to the learners. Many scholars hold neutral or negative attitudes towards gamification, considering the effects of reward (Deci et al., 2001; Hanus & Fox, 2015). Nevertheless, in this study, the GES has provided compelling evidence that students who read extensively on the e-learning platform have exhibited increased reading interests, good reading habits, improved reading abilities and positive motivations, after they stopped using the platform for six months. These results imply that extrinsic motivation to read has been internalized by these students to some extent and sustained well after the GES usage. The results of this study suggest that gamification and gamified pedagogies could play a positive role in developing elementary school students' reading literacy, probably through intrinsically motivating students to keep reading. The results may offer valuable evidence to teachers, students, and their parents, about the potential of gamification in positively influencing students' reading interests, reading habits, reading ability

and reading feelings. Future work will further this line of investigating longer-term effect of the GES with larger samples.

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